THE

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THE

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1902 Edition

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OUR NAVY BOILERS.

IT is now reported that the first six cruisers of the 1901-2 programme, at present under construction, shall have a composite boiler equipment as follows. The proportion of boilers is given in fifths of the whole quantity :—

H.M.S. *Devonshire*, Niclausse 4, cylinder 1.
H.M.S. *Hampshire*, Yarrow 4, cylinder 1.
H.M S. *Carnarvon*, Niclausse 4, cylinder 1.
H.M.S. *Roxburgh*, Dürr 4, cylinder 1.
H.M.S. *Argyll*, Babcock 4, cylinder 1.
H.M.S. *Antrim*, Yarrow 4, cylinder 1.

All these vessels are of one class of 10,200 tons, and specified speed 23 knots. One-fifth of the total of 132,000 H.P. is to be produced from cylindrical boilers. The chief interest in the announcement is that there are no Bellevilles to be fitted. It is something to have got rid of that boiler. Writing in the *Pall Mall Gazette*, Mr. W. Allan condemns all water-tube boilers alike, and considers that the above scheme is condemned to the same failure as was the Belleville. He gives some very startling figures and facts as to the failure of ships in which some of the boilers named have been tried, namely, the Babcock boilers in the ss. *Norman Isles*, and the ss. *Scottish Hero*. Other boilers not named above failed in other ships, notably the Howard boiler in the ss. *Mark Antony* and *Fairy Dell*. We knew something of the Howard boiler years ago, and can understand its failure. It was constructed so that it must have failed.

Mr. Allan cites no instance, we fancy, in his list of a small "vertical" tube boiler failing, and we cannot go so far as Mr. Allan in his wholesale condemnation of all water-tube boilers.

The profound ignorance of most water-tube boiler men on questions of furnace design gives us reason to doubt the capacity of any one of the six cruisers to run smokelessly on anything but Welsh coal, if they even succeed in doing it on that. But does not Mr. Allan overstate his case? All water-tube boilers must not be classed with the Belleville. We never have so classed them, and have, indeed, protested against the disingenuous manner in which the Admiralty have covered their blunder by confusing the issue between water-tube boilers in general and their pet failure in particular. We think no harm of a few small experiments being made where these are justified. A question of some moment is whether our Navy boilers ought to be capable of burning coals of a bituminous nature—Scotch, Lancashire or Durham, as well as Welsh—without smoke. If this be necessary, then we agree with Mr. Allan that on this point the Admiralty's new scheme is unlikely to be successful. None of the boilers in the above list appears to us capable of being arranged in a ship of war so as to give perfect combustion. We may be wrong in this statement; most of them could be set so as to be practically, if not absolutely, smokeless on land. But there are certain limitations as to space on board ship, and more especially on a warship, whereon water-line means so much, that no argu-

ment based on land practice can be applied to naval practice.

All through the past few years of discussion on the Belleville boiler, it has been loudly proclaimed that the Messageries Maritimes used the Belleville boiler, and found it a complete success. Mr. Allan told the House on May 29th that this great line was discontinuing the use of the boiler, and Mr. Arnold Forster practically denied that the Boiler Committee had condemned the Belleville, whereupon Mr. Allan invited him—very properly, too, in face of well-known facts—to *be square*.

As to the general idea that water-tube boilers are an absolute necessity in the Navy because of weight and of the tearing up of decks to remove the cylinder boiler, it has never yet been shown that the weight theory told in favour of the water-tube boiler, and it cannot, surely, be urged that the Admiralty ought to do so much worse in boiler affairs than was proved possible by the ss. *Britannic*, which ran 25 years with her original boilers, and only then changed them—and the engines—because of triple-expansion and the higher boiler pressures now possible.

Do our ships of war remain serviceable as ships anything like 25 years? We trow not. Why, then, make so much fuss over cylinder boilers, which would not require changing in a ship's useful life if the Admiralty would be guided by the reasons that guide the design of a liner and would pay men properly to look after the machinery. We condemned the experiment on the *Powerful* and *Terrible* as too huge, at the time, apart from the foregone conclusion of failure that was too obvious to any engineer. And the present experiment seems also on the side of extravagance.

Six cruisers are to be more or less complicated in their arrangements by having two types of boilers put into them. Yet there will be boilers enough in any one of them to have made the experiment on all four boilers named as well as the cylindrical. Such an experiment would have been justifiable. The ship might have been named H.M.S. *Rattletrap* with great propriety. We will not, however, complain unduly. Even if they smoke badly, the proposed boilers are not of the extremely dangerous type. Reasonably sound material is likely to stand the stresses involved. It is to be hoped for the sake of the water-tube principle that the Admiralty will not revert to lap-welded tubes, though it may also be hoped that the nickel steel necessary in the Belleville boiler will no longer be required. None of the proposed boilers has a long tube of the manifold type, which has always seemed to invite danger.

The Yarrow boiler has steeply inclined tubes; the Dürr boiler is a modified Field tube boiler, with the Field tube inside another tube open at one end only. So is the Niclausse. The Babcock boiler is a nest of inclined through tubes of no great length. The Field tube principle is correct enough within reason. Much cannot, however, be said in favour of any of the proposed boilers from the point of combustion. Welsh coal is costly, and the supply is not unlimited. We allow the so-called coal owners to sell it to the foreigner for use against ourselves, to their great profit and this country's great loss. Yet the new boilers must have Welsh coal if they are not to show their course in the sky.

Much that Mr. Allan writes is well put. He has done good service, and he has been consistent on the boiler question; but we think he goes too far.

We might point out to him that very large numbers of water-tube boilers have been for some years at work in most electric light stations with very fair safety, even if with much trouble as regards smoke, and we would emphasise the fact that water-tube boilers to-day are very different from the Howard safety boiler which some years ago exploded so often and so fatally, and so signally belied its name.

Mr. Allan very properly condemns the defence of the Belleville type by First Lords and Secretaries, "the theses read before Institutions by Admiralty officials," and so on. It has all been very lamentable, but we must not, on that account, condemn all experiment, if such experiment is kept within *reasonable bounds*. We italicise the term, as we fear the proposed experiments are too extravagant.

There has been so much public scandal over the whole subject of naval boilers, that the taxpayer may very properly ask reason for the faith that is in the Admiralty. Have they reasons for their present course of action that will appeal to the majority, say, of the chief engineers of the Cunard Line?

Can they show that the new boilers they propose to try have already shown qualities of safety, smokelessness and durability sufficient to warrant so extended a trial as is indicated, which may after all mean the virtual crippling of, say, three of the selected cruisers? How far is the Boiler Commission responsible for the new departure? So far their recommendations have not, we believe, been placed on record nearly so strongly as if they had been the recommendations of consulting engineers advising a private firm. The suspicion that officialdom has been let down gently obtains strongly.

Cable Relays.

In another column we commence to print the paper read by Mr. Brown before the Institution of Electrical Engineers on May 1st, upon "Automatic Relay Translation for Long Submarine Cables." In the course of the discussion which followed the reading of the paper, the concise remarks of Mr. Judd, whilst doing justice to the beauty and ingenuity of the new relay, served to temper the somewhat unmeasured praise bestowed upon it by certain other speakers, whose enthusiasm outran their discretion. Mr. Judd's observations were the more valuable as coming from one who speaks with authority and from actual experience of the working of the apparatus when used for relaying traffic messages from one long cable to another. A notable point in the discussion was made by Mr. H. W. Sullivan, who traversed the inventor's statement as to the unreliability for cable working of butt contacts, mentioning that just recently he had himself successfully tried a new relay with butt contacts of his own design upon a considerable length of laid cable. We understand that Mr. Sullivan is now introducing certain improvements in his instrument, and that it is shortly to undergo further practical cable trials; we shall await particulars and the result with interest. In the absence of sufficient information in Mr. Brown's paper upon essential points (especially the local correction device), we are unable to criticise the "drum" relay in detail; but speaking in general terms, and from a knowledge of cable working extending over many years, we are of opinion that in its present form the apparatus, with its many auxiliary parts, is too complicated for the practical working requirements of a cable station. There is so much in it to go wrong. It seems to us that it will need considerable attention, especially in the tropics, and that at each intermediate station, if traffic delays are to be avoided, it will be necessary to have a skilled man to keep watch and guard over it.

THE NATIONAL PHYSICAL LABORATORY.

The Electrical Equipment.

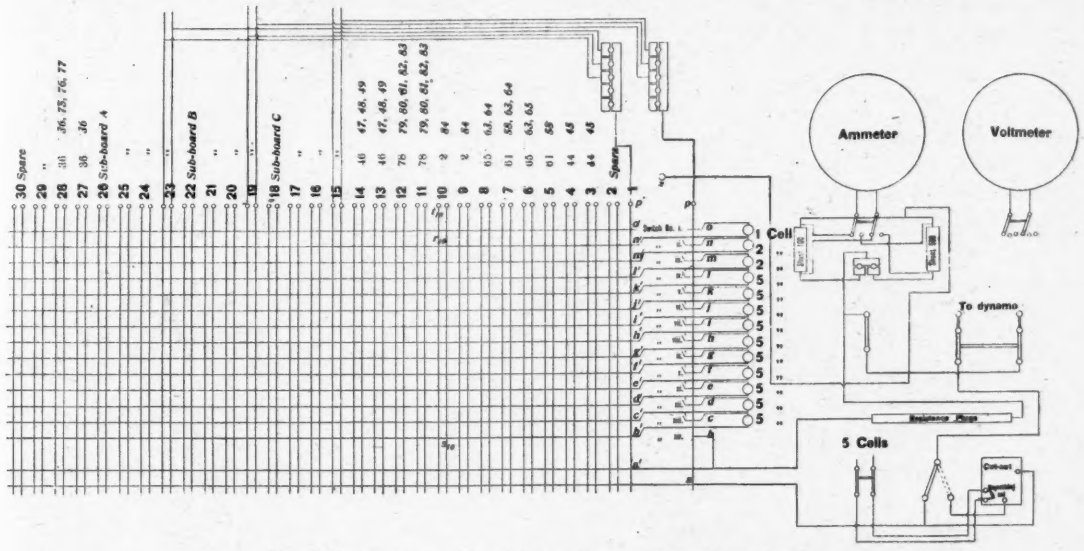
By ALBERT CAMPBELL, B.A.

Although the equipment of the laboratory is proceeding as quickly as the available funds permit, it is still far from complete, and much of the time of the staff is at present devoted to it. In the electrical department enough has been done, however, to enable the Director to undertake immediately a tolerably wide range of measurement. A brief description of some of the apparatus may therefore be of interest to readers of the Electrical Review. With regard to the generating and distributing plant, it is sufficient to remark that a supply of current is obtained from a 60-kw. dynamo, driven by a Parsons steam turbine, and in addition to this machine, there is a smaller dynamo, with a Crossley gas engine, and a motor-generator, which can be used as a booster or alone. Ample storage capacity is afforded by three batteries of Chloride cells, each battery giving at least 105 volts; one of them is reserved exclusively for electric heating in the thermometric department. Arrangements for a supply of alternating current at various frequencies are under consideration.

There are three rooms devoted to purely electrical work. The smallest of these is in the basement, and has connected with it cellars which are admirably adapted for preserving constant temperature. The room itself is provided with a thermostat, by which the gas heating is regulated, and a steady temperature obtained. The working substance in this thermostat is silver ammonium chloride, a compound which gives a large variation in vapour pressure for a small change of temperature near 15° C. In this room are the British Association standards of resistance, and a Carey-Foster bridge for comparing resistances to a high degree of accuracy. In addition to the historic B.A. coils, which have already done such good work, there are a number of modern manganin standards. Low-resistance standards, capable of carrying large currents, are also being constructed, and as the cooling surface allowed in these is much larger than that found in commercial shunts, a very high degree of accuracy is thus attained. As standards of potential difference, a number of H-form Clark cells have been constructed, and most of these will be kept permanently in the constant-temperature room, from which well-insulated leads will run to the other electrical rooms. As secondary standards, a number of cadmium cells have also been made, and it is expected that these will prove more convenient than the Clark cells, as their temperature coefficient is so very much smaller.

The largest electrical room is to contain primary standards, a large concrete slab being reserved for a Lorenz apparatus for the absolute measurement of resistance; but the fitting-up of instruments in this room has scarcely begun. A part of the room is at present occupied by a potentiometer, consisting of very accurate standard coils, and this is being used for the purpose of adjusting standards of low resistance. There is also here a convenient form of Thomson low-resistance bridge, by which commercial tests of copper conductivity and the like are rapidly carried out. A high resistance potentiometer is also available for voltage comparisons.

In the other main electrical laboratory are being set up a number of secondary standards. A Kelvin current balance reading to 100 amperes is already in position, and near it is a specially designed Kelvin reflecting electrostatic voltmeter, with a very long scale bent into a circle of large radius. As this scale is about 4 metres long, a change of 1 volt at 100 volts moves the light spot through 4 cms. The instrument reads directly to 160 volts, and in order to adapt it to the measurement of direct or alternating voltages up to 1,000 or 2,000 volts, a potential-dividing box of 100,000 ohms has been constructed. The 10 coils in it are wound in 100 separate sections on a wooden frame, well shellacked and baked, and each section is non-inductive. Some of the coils are further sub-divided to enable the voltmeter to be calibrated by direct comparison with a standard cell. In using the box, the high voltage, v, to be measured, is put across the total 100,000 ohms, and the voltmeter terminals are connected to points giving a suitable fraction of v for the instrument to measure. In a corner near is at present



Main Switchboard. Diagram of Connections. (See p. 929.)

set up an accurate Wheatstone's bridge of six dials with manganin coils.

The rest of the room is mainly devoted to capacity and inductance work, the latter including the magnetic testing of iron. The most prominent objects in the room at present are the two large air condensers of the British Association, which stand on a marble-topped pier specially built for them. They consist of a large number of concentric brass cylinders supported in such a way that the alternate ones are insulated from the others, the dielectric substance being dry air; the capacity of each is about 0·02 microfarad. Anyone who has been worried by the effects of residual charge and leakage in ordinary condensers with dielectric of mica or paraffined paper will at once appreciate the advantages of standards in which the solid dielectric is replaced by air; in fact, Dr. Glazebrook's experiments some years ago amply proved the trustworthiness and convenience of such condensers. Since they have been erected in the laboratory, their absolute values have been redetermined by the following method. The condenser, with a suitable commutator, is made one of the arms of a Wheatstone's bridge, and the commutator is rotated at a uniform speed in such a way as to charge and discharge the condenser. The condenser arm of the bridge thus transmits a pulsating current,

and becomes equivalent to a resistance. If the moving part of the galvanometer has a sufficiently slow time of swing, a balance can be obtained in the ordinary way, and the capacity of the condenser calculated from the values of the resistances and the frequency of commutation. The speed of the commutator is regulated by the aid of a stroboscopic disc which is viewed through the slits carried by an electrically-driven tuning-fork, friction being applied by a cord to a pulley on the disc so as to keep the image seen through the slits steady.

On a table close by is arranged the apparatus for Lord Kelvin's method of comparing capacities, and by it a number of commercial condensers are being compared with the air standards. From the standard capacity can be obtained a standard inductance (self or mutual), or, what is, perhaps, of more interest to electrical engineers, a *standard of magnetic flux*. Accordingly not far from the condensers are found ballistic galvanometers, mutual inductance coils, and all the arrangements for the complete testing of iron and steel rings for magnetic permeability and hysteresis. In addition to this there is a Ewing permeability bridge of the latest pattern, with the additional apparatus necessary for the calibration of the standard bars. Commercial testing of transformer sheet has already been taken in hand.

Makers and users of glow lamps will be pleased to hear that the Director hopes before long to have facilities for testing these for candle-power, efficiency and life. It is unfortunate that in this country the photometric standards used by different people differ very widely from one another, variations of 10 to 15 per cent. being not uncommon. It is hoped that the laboratory may help to remedy this state of things, and promote a uniformity in light standards such as the work of the Reichsanstalt has brought about in Germany.

To the engineer as well as the electrician the Thermometric Department presents much of interest. Engineers will be glad to learn that good mercury thermometers can now be obtained which read up to 500° C.; to keep the mercury from boiling at such high temperatures, the part of the thermometer tube above the mercury is filled with nitrogen under pressure before the end is finally sealed up. We understand that such thermometers are now beginning to be manufactured in this country, and it is hoped that many of them will find their way to the Laboratory for verification. One of the baths in which these thermometers are tested is filled with a mixture of nitrates of potassium and sodium, which is more fusible than either of its component salts. The mixture is kept melted by means of gas burners, and constant circulation is obtained by aid of a stirrer driven by an electric motor. The thermometers are in steel tubes to protect them from direct contact with the liquid. In many industries the importance of measuring quite high temperatures is now being recognised; accordingly the laboratory possesses very complete arrangements for testing resistance thermometers, thermo-junctions, and other pyrometers for the measurement of temperatures up to 1,300° or 1,400° C. As the ultimate standard of reference an elaborate gas thermometer has been set up, and with this are compared the working standards, which are platinum resistance thermometers, and thermo-junctions of pure platinum with platinum-rhodium or platinum-iridium alloy. In this country the ease with which such thermo-junctions can be used for measuring high temperatures is not yet sufficiently appreciated. A thermo-junction occupies very small space, and has extremely small heat capacity. To obtain an efficient pyrometer it is only necessary to combine with the junction some means of measuring the voltage produced. In many cases a galvanometer is all that is required for this. From the quickness and handiness of the method, it is to be employed in the alloys research to be carried on by the metallurgical department of the laboratory.

For obtaining the necessary steady high temperatures, two electric ovens have been set up. These consist of sets of porcelain and fireclay tubes arranged concentrically. Round one of the tubes is a long spiral of nickel wire, and this is heated by a current taken from a special 100-volt battery of large capacity. With a current of 15 or 16 amperes a beautifully steady and uniform temperature of 1,100° to 1,200° C. can be obtained inside the innermost tube. The whole oven is so well lagged with non-conducting material that the temperature of the outside is quite moderate. In one of the ovens the insulating lagging round the nickel coil consists of powdered silica, which has been made from quartz by heating it to redness and quenching in water. The cleanliness of these ovens and the comfort in working them fully exemplify the advantages of electric heating.

In conclusion, it should be mentioned that the electric equipment of the laboratory is only in progress, and that before long there will be set up apparatus for supplying high voltages and for testing insulation resistance, as well as for carrying out many other tests of great importance to the electrical engineer.

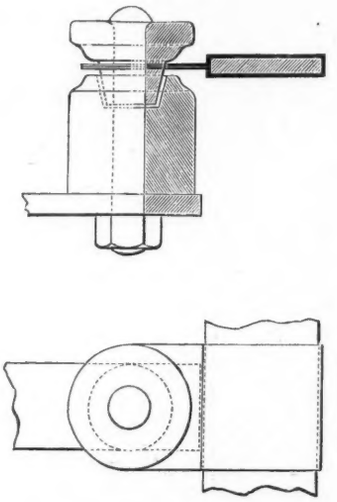
Wiring for Experimental Work.

By W. P. STEINTHAL, M.Sc.

The general scheme which I am about to describe is based to some extent on the experience gained in the equipment of the new physical laboratories at the Owens College, Manchester. The system is somewhat similar, though the exigencies of the building itself and the differences in the requirements of the two institutions rendered certain modifications, from the plans adopted at the Owens College, essential.

In the first place, it was found impossible to work entirely with bare conductors; in fact, when the scheme was first prepared, there was some doubt as to the advisability of using bare conductors at all. However, the great saving in cost, together with the great convenience obtained for making alterations or additions, decided in favour of bare conductors wherever possible.

It was, therefore, arranged that all conductors should be bare, with the exception of the conductors connecting the main switchboard with the branch distributing boards, and the conductors in those rooms where the magnetic effects of the conductors themselves had to be considered.



Insulator and Clamp (Half full size).

In the former case the conductors consist of high conductivity copper insulated with impregnated paper and lead covered. In the latter the conductors are concentric, the insulation being as above, and the whole conductor lead covered.

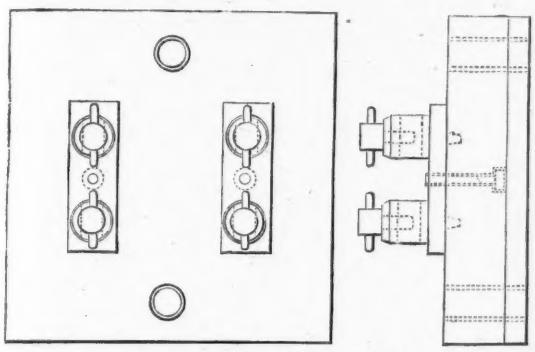
As this form of insulation is extremely hygroscopic, and deteriorates rapidly if exposed to the atmosphere, the ends of all cables, where connections are made to boards or terminals, are sealed with porcelain end connectors filled solid with paraffin wax. The bare conductors are run on porcelain insulators bolted to iron straps and brackets.

The wire is soft-drawn high conductivity copper, No. 4 gauge being used for 100-ampere circuits and No. 8 gauge for 50 amperes.

Current is obtained from two batteries. One of these batteries, situated near the main switchboard, described later, consists of 55 R-type Chloride cells, arranged in 13 groups, 10 of five cells, two of two cells, and a single cell.

The second battery, situated in one of the wings of the building, and provided with its own charging and distributing board, of similar design to the main board, consists of 56 R-type Chloride cells, arranged in four groups of 14 cells each.

Main Switchboard.—This consists of two parts; one part contains the ammeter, voltmeter, main switch and fuses, automatic cut-outs and resistance plugs: the other a series



Terminal Block (Half full size).

of switches for connecting the cells in various ways, and a set of vertical and horizontal bars for connecting cells to circuits as required.

The actual connections will be clear on referring to the diagram (p. 927). It will be seen that there are 30 circuits from the main board. No. 1 circuit is for heavy currents up to 500 amperes, and is first taken to a subsidiary five-way plug-board, three circuits from which have a capacity of 100 amperes, and two of 500 amperes.

To get current above 50 amperes, groups of cells have to be arranged in parallel, and this is effected by means of the switches on the extreme right of the plug board.

If all the switches are closed, it will be seen that each group is in series, whereas if all the switches, with the exception of No. 2 and 3, are open, the cells can be arranged in 11 groups of five in parallel.

The boards are built of slate slabs, mounted on wrought-iron frames; the bars at the front of the board are vertical, of rolled brass, polished and lacquered, those at the back being horizontal, and left unpolished. By means of holes at every intersection and suitable plugs, any horizontal bars can be connected with any vertical bar.

Referring to the diagram, the number in Roman type opposite a circuit represents the number of the room in which that circuit ends, the italic numbers the rooms into which tappings off the circuit are taken.

The following schedule, in conjunction with the diagram, will show the various connections :—

(*a*) To charge the whole battery.	Close switches I. to XIV., insert plugs at a, o.
(*b*) To charge, say, the 5th group alone.	Close switches V., VI., XIV., insert plugs at a, k, j', a'.
(*c*) To discharge whole battery on to any circuit with resistance and ammeter in the discharge circuit (say, circuit 10).	Close switches II. to XIII., open switches I., XIV., insert plugs at o, b, s_{10}, connect x to t_{10}.
(*d*) Ditto ditto without ammeter and resistance.	Close switches I. to XIII., insert plugs at t_{10}, s_{10}.
(*e*) To discharge, say, 3 groups of 5 in parallel with ammeter and resistance on to circuit No. 1.	Insert plugs at i, h, g, b, connect x to p, remove fuse at p, insert plugs at f', g', h', open switches VII. to X.
(*f*) Ditto ditto without ammeter and resistance.	Insert plugs at i, h, g, insert plugs at f', g', h', open switches VII. to X.

The ammeter is an Evershed moving-coil instrument with two shunts for 100 and 500 amperes.

The voltmeter is a Kelvin electrostatic instrument, switchboard pattern,

The resistance consists of seven steps having values ·025, ·05, ·1, ·2, ·3, ·4, ·5 ohm.

The ends of each resistance are brought to blocks with plugs between each block, similar to the Post Office resistance box, so that by inserting the correct plugs, any resistance between ·025 ohm and 1·575 with differences of 025 can be obtained.

A portable voltmeter is provided, and the plugs are made so that a connector can be taken from the plugs to the voltmeter, and the operator can ascertain the voltage that he is putting on to a particular circuit.

There are three subsidiary plug boards in various parts of the building, called A, B, C.

Board A is fed by circuits 23 to 26,
„ B „ „ 19 to 22,
„ C „ „ 15 to 18.

Of the four circuits to each of these boards, one is for 100 amperes and three for 50 amperes. Each branch board has 10 horizontal bars, eight connected to the main board and two spare, and 20 vertical bars providing for 10 circuits from the board.

Each board is provided with a volt gauge and loose connectors for connecting the voltmeter to the plugs or the horizontal bars.

On the main switchboard an automatic cut-out of the Crawley type is fitted. The magnetising coil is separately excited by a group of five cells. The shunt coil is split up into sections which can be cut out in succession, according to the number of cells which it is desired to charge.

For connecting apparatus to the circuits, the conductors are led to terminal blocks, consisting of enamelled slate blocks 4 in. square, fitted with brass terminals, as shown in the adjoining sketch. Under the head of the terminal screw a washer is provided, so that fine wire can be connected in addition to the wires or cables that can be clamped in the terminal hole. Where high insulation is required the slate block is mounted on ebonite, and the screw holes are bushed with ebonite.

Circuit No. 1 for currents up to 500 amperes consists of copper strip $1\frac{1}{2}$ in. × $\frac{1}{4}$ in., fixed on insulators by means of brass clips (see figure on p. 928).

The circuits generally show an insulation resistance of about five megohms.

Certain very delicate tests with very small voltages require a higher insulation than this. For these experiments the system of conductors is not suitable, and portable accumulators will be used instead of using the supply from the main batteries.

A RECORD IN STEAM-RAISING FROM LONDON REFUSE.

The scepticism of prejudice is, as ever, best met by the argument of experience. To the question "Can any good thing come out of refuse?" the answer is, "Come and see;" or, in the modern equivalent by Meldrum Bros., "Go to Grays." We accepted the invitation. We went to Grays, as Grays Thurrock is generally called, and saw the combined refuse destructor and electric generating works in everyday operation. The electric station contains two steam sets of 100 kw. each at 460/500 volts, a balancer booster, and battery of accumulators. The boiler room contains two 30 ft. × 8 ft. Lancashire boilers adapted for coal firing. These are used only when there is an insufficient supply of refuse to burn in the destructor. The destructor house is separate from the main boiler house, and contains two 2-grate Meldrum regenerative "Simplex" destructors, working in conjunction with a Lancashire boiler 20 ft. × 7 ft., and a regenerator for heating the air supplied to the furnaces.

The gases after leaving the furnaces pass through a combustion chamber, where most of the dust settles, then through the boiler flues and regenerator, and into the chimney, either direct or through an economiser. The plant is arranged so that dust may be raked out of the combustion chamber, boiler downtake, and regenerator, and can therefore be run for about three months without stoppage.

The normal burning capacity of each furnace is one ton per hour, although it is capable of working up to double this capacity in case of necessity. The destructor does not work under its best conditions, nor does any destructor which has to supply steam for a lighting load only. To do its best, the furnaces of a destructor should be kept going night and day. In this instance, the plant only works for six or seven hours a day,, when the fires are burned out, and the destructor is allowed to stand idle during the remainder of the 24 hours. We timed our visit so as to arrive at about starting-up time. Although the fires had been out and the furnace doors left open for some 17 or 18 hours, the gauge indicated a boiler pressure of about 100 lbs. Had the doors been left closed, steam would have blown off during the night due to the heat stored in the brickwork. The amount of heat necessarily wasted, therefore, due to the nature of the load, is very considerable. Within an hour of starting up from cooled furnaces, the generating plant was charging the accumulators.

The maximum load on the station is 80 KW., and this is easily maintained by the consumption of about two tons of refuse an hour. On an average 12 tons of refuse per day (about six hours) are burned. Two stokers and a trimmer are employed, so this averages one ton per hour per stoker, which means very easy firing, as double this duty might be obtained. The maximum output in KW-hours per ton averages about 35.

The following figures from a 7-hours' test made on January 23rd last constitute, we believe, a record for what may be called "London refuse," which has a lower calorific value than the refuse in many northern towns, more particularly colliery towns. The grate area is 50 sq. ft., the heating surfaces of the boiler and economiser are 600 and 1,408 sq. ft. respectively:—

Total weight of refuse consumed, including pots, tins, &c.	26,684 lbs.
Do. do. per hour	3,812 „
Refuse consumed per sq. ft. of grate per hour	76½ „
Total water evaporated	27,100 „
Do. do. per hour	3,871½ „
Water evaporated per lb. of refuse	1·01 „
Do. from and at 212° F.	1·22 „
Temperature of feed water	50° F.
Do. water leaving economiser	299° F.
Average steam pressure	144 lbs.
Total heat units in steam generated	4,544,554
Heat unit from economiser (= 21·2 %)	967,750
Board of Trade units per ton generated during last 4½ hours; the boiler blowing off	35·5
Do. do. during 3 hours	42·4

These are the best results we have yet seen, and it is evident that under more favourable working conditions, these figures could be improved upon.

During the first part of the test the cooled brickwork would absorb a considerable proportion of the heat generated, and the figures show that the results in the last three hours were better than those covering a period of 4½ hours. It is only reasonable to suppose that the figures for the last hour alone would be higher than 42·4 units per ton, and might have been higher still if the test could have been prolonged to 24 hours.

It is equally obvious, judging from the temperature of the feed-water leaving the economiser, that the boiler is not well proportioned to the work; its length was, we understand, restricted owing to the space available. A 30-ft. boiler would have increased by 50 per cent. the length of the heating surface, that is, the gases would have had to travel for a distance of 90 feet in contact with the boiler plate, instead of only 60 feet as at present, and the temperature of the gases in the chimney would then have been considerably reduced.

Neither smoke nor dust was visible from the chimney during our visit, nor was the locality of the destructor indicated by the smell! The only objectionable feature at all was the dust with its characteristic odour blowing from the clinker yard.

We are pleased to have had an opportunity of seeing what can be done with a well-designed destructor plant, a plant designed primarily and essentially to *cremate refuse*, and which on that account may be usefully and profitably employed in connection with steam raising plant.

COMPARATIVE TELEGRAPHIC DELAYS.

SIGNOR ETTORE ROSSI, of the Roman telegraph service, has recently made a tour of the principal telegraph offices of the world, and has published the results of his observations in the current number of the *Giornale dei Telegrafisti*, a Milanese professional organ. Among many interesting details the following tables appeal to us as being of exceptional value, and worthy of reproduction. Table I. shows the average time occupied by a message at the various stages of its transmission. The delay accruing in the office in despatch is shown in the first column. The second column shows the delay in the delivery, and column three shows the time occupied at the wires.

Table II. shows in the first column the average number of messages per day passing through the office named, the second column shows the approximate number of the staff, and the third column shows the average daily work of each member of the staff. Some interesting notes are appended to Table II.

TABLE I.

	Average time in minutes occupied by a telegram in—		
	Despatch.	Delivery.	Transmission.
Alexandria (Egypt) ... (Eastern Tel. Co.)	6	4	6
Brussels	12	5	7
Athens	15	7	12
Bucharest	18	10	15
Berlin	27	5	18
London	25	12	20
Munich	30	10	21
Buda-Pesth	30	10	25
Vienna	35	10	22
Paris	45	17	25
Pera	40	23	32
Rome	105	50	90

TABLE II.

	Average number of telegrams daily.	Number of staff.	Number of telegrams per employé per day.	
Buda-Pesth	31,000	320	96·8	
London	475,000	5,000	95	
Paris	120,000	1,300	92·3	(1)
Alexandria (Egypt) ...	7,000	80	87·5	(2)
Brussels	18,000	244	73·7	(3)
Munich	11,000	150	73·3	(4)
Vienna	45,000	700	64·3	(4)
Berlin	89,000	1,500	59·3	(4)
Rome	14,500	315	46·7	(5)
Pera	3,500	80	43·7	(6)
Athens	2,200	62	35·5	(7)
Bucharest	6,000	180	33·3	(6)

1. It must be noted that the French language has a longer average word than the English, and the mean of 92·3 really represents a higher average than the 95 of London (the relation of the English to the French "telegraphic" word is as five letters to 5½ letters. *Tr.*). The high average in France is largely due to the general use of the Baudot.

2. Even taking into consideration that the average message is 12 words, the individual work is about the same as no fast apparatus is in use.

3. In Brussels the rapidity of transmission is obtained by means of a large staff employed on collecting, supervising and distributing work, and this speed is obtained at the expense of the mean individual output.

4. The Hungarian language has a large number of long words, and in the German confederation fast Wheatstone and Baudot apparatus is not generally in use.

5. This average is low, but in Italy a number of the telegrams are longer than elsewhere. The minimum charge of one lira allows 15 words for Inland telegraphs, whilst in other countries the minimum of 5d. or 6d. allows only 10 or 12 words for each Inland telegram. In any case, the average is low, however, when one takes into consideration the heavy delays on all kinds of telegrams.

6. This average is low and is due largely to long lines and small amount of work.

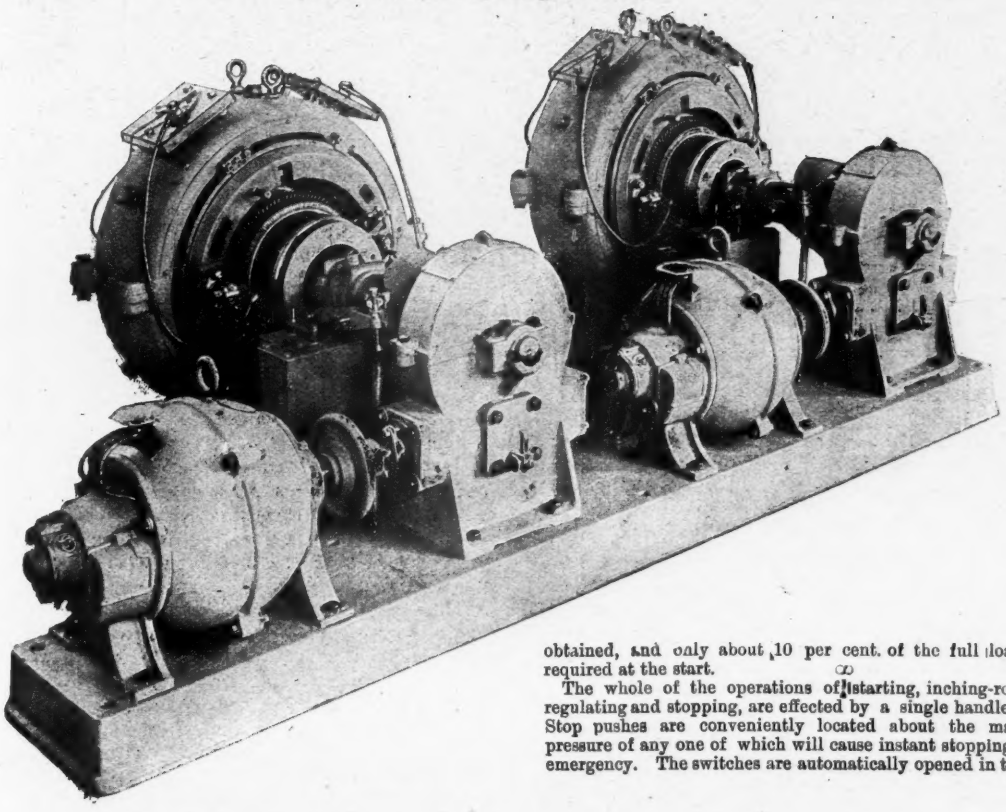
7. As in note (6) and probably the absence of fast apparatus.

ELECTRICALLY-DRIVEN PRINTING MACHINERY.

FEW arts have benefited more by the adoption of electricity as a motive power than the art of printing, yet few instances of the application of electrical driving are more exacting in their require-

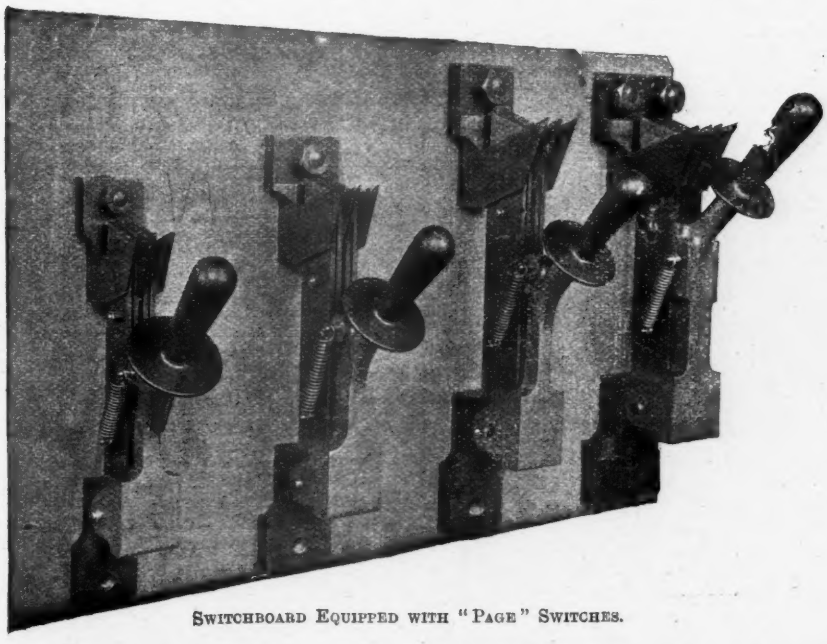
ments. The range of speed required is from full speed to a mere crawl—"inching-round;" the driving agent must be at all times absolutely under control, easily started and stopped as often as required (and that is very often), perfectly uniform in turning moment, and, above all, reliable. The problem is a difficult one, even for electricity; it has, however, been completely solved, with the result of a markedly increased output and efficiency at lower cost. Three or four years ago the Holmes-Clatworthy system of electrical driving was devised, mainly for this purpose, and was applied to several large rotary web newspaper machines; as proof of its success, we understand that Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, have more orders in hand for these equipments at the present time than ever before, and the fact that a great many of these are repeat orders speaks for itself. Reference has before been made in the Electrical Review to this system, but a further description of the "parallel" driving may be interesting, as an illustration of this method has not hitherto been published. The reason that special apparatus is required for driving this machinery is on account of the heavy starting torque necessary, amounting to at least 1½ times the full running torque; further, the machine must be started absolutely without any jerk, and must run at an extremely slow speed for leading in the paper from the reel, round the printing cylinder and guide rollers, &c., to the folder and delivery. In the Holmes-Clatworthy system the main motor is shunt wound (never being overloaded), and is geared direct to the machine-driving shaft. An auxiliary motor, capable of giving a greater turning effort to the machine at the slow speed than the large motor, drives the machine through worm gear and an electrically-operated claw clutch, the latter being so designed that it will come out of gear and stop the auxiliary motor as soon as the main motor over-runs the auxiliary and drives the machine by itself. A very wide range of speed is

Holmes-Clatworthy Double Equipment.



obtained, and only about 10 per cent. of the full load power is required at the start.

The whole of the operations of starting, inching-round, speed regulating and stopping, are effected by a single handle or wheel. Stop pushes are conveniently located about the machine, the pressure of any one of which will cause instant stopping in case of emergency. The switches are automatically opened in the event of the current supply failing, or of overload due to an accident to the printing machine such as a bearing seizing, breakage, or paper wrapping round the cylinder.



Switchboard Equipped with "Page" Switches.

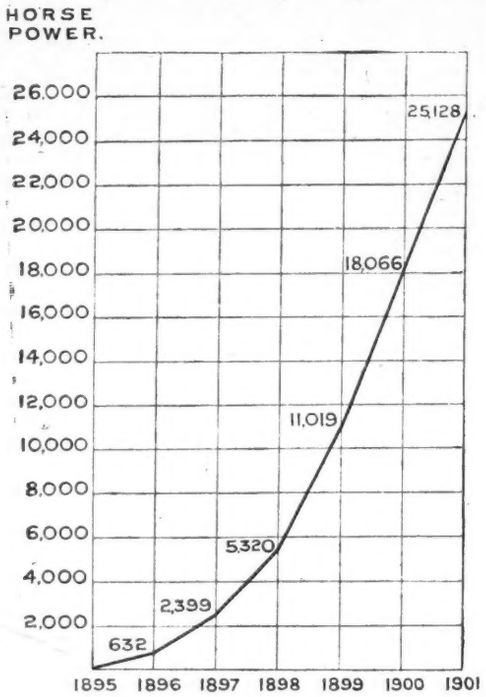
The main driving motor is of just sufficient size and power to drive at full speed the printing machine to which it is geared, and this motor is never called upon to exert more than the full normal output, so that it works under the most economical conditions.

The machine cannot be started from rest without using the

auxiliary motor, though the power is always transmitted through the large motor shaft. The large motor is thus always in motion before it is called upon to exert any power.

A large printing machine is frequently required to work in distinct sections when printing evening papers, and as a whole when printing morning or weekly papers. A special feature of the Holmes-Clatworthy system is that it may be applied in two sections to one machine, each with its own independent controlling apparatus. When the machine is to run as a whole the two sections are coupled up mechanically; the controllers are also coupled so that one handle operates both equipments simultaneously. By special connections a perfect balance of the load is obtained on the two equipments at all speeds, and the arrangement has proved perfectly satisfactory in practice.

The illustration on the preceding page is taken from a photograph of two 25 B.H.P. Holmes-Clatworthy equipments arranged on one bed-plate in the manner above described, for driving a large press by the Northern Press and Engineering Company, South Shields.



ANNUAL OUTPUT OF LUNDELL MOTORS.

These equipments are sunk in the floor of the machine room. Economy is a great feature of this system, and over 1,000 eight-page papers can be printed at a cost of less than 1¼d. for energy.

It will be noticed that the motors are of the Lundell type, for which Messrs. J. H. Holmes & Co. hold the British patents. The extraordinary popularity of this motor is evidenced by the curve which we reproduce herewith. It will be seen that in six years' time the sales have increased to an annual amount of over 25,000 H.P.

The remaining figure illustrates the "Page" type of switch which Messrs. J. H. Holmes & Co. are manufacturing. The special feature of this switch, to which we would call attention, is the simple but effective device by means of which the working parts are kept clean and free from burning. It will be seen that the ends of the switch blades and of the jaws are so bevelled that the spark at breaking is forced to the extreme tips; when the switch is closed, the clean surfaces alone are in contact. The blades are also separate, with "Thackeray" washers between them, so that while they are quite loose when the switch is open, they exert a considerable pressure on the contact surfaces both of the jaws and of the pivot when the switch is closed.

THE EDISON ACCUMULATOR FOR MOTOR CARS.

BY W. HIBBERT.

THE somewhat excited state of last week's newspapers about Mr. Edison's battery again reminds us of the fact that we are to expect something from his hands. It is difficult to say how far Mr. Edison is responsible for the declarations made in his name. Many of these are repetitions of those made in a much more definite way by Dr. Kennelly to the American Institute of Electrical Engineers a year ago. (ELEC. REV., June 7th, 1901.)

Mr. Edison then claimed (through Dr. Kennelly) that his nickel-iron alkaline cell did not deteriorate, had a large storage capacity for unit weight, was inexpensive, would withstand careless treatment or much abuse, and could be rapidly charged and discharged.

In the present newspaper accounts these claims are revived, but with special reference to the rapidly-growing motor car industry. It is stated that there has been a prolonged motor car run, exceeding any hitherto obtained with lead cells. This in itself is good, but responsible engineers have got beyond the stage of deciding any large question on the strength of a single experiment, especially when only one or two data are given as far as figures are concerned. It is noteworthy that even in these accounts Mr. Edison says he is about to try a 5,000-mile road run in order to determine reliability under the actual stresses of motor car work. As Mr. Edison is a man with unlimited resources, it is certain that the past year has not been an idle time for his accumulator, so that the fact that the road trial has not been made makes it probable that he has been dealing with other problems which were unsolved when Dr. Kennelly read his paper.

From various journals, these figures are to be gathered :—

Weight of 21 cells, 332 lbs. Run on roads of varying grade and quality, 62 miles; on comparatively level ground 85 miles were run before the vehicle came to a standstill. The charging requisite for a 20-mile run can be done in 40 minutes. The proportion of weight to power (*sic*) is said to be 53 lbs. for 1 H.P.-hour. Mr. Edison's immediate object is to produce a 100-mile battery.

It need not be said that such data as these are of no use. If we go to Dr. Kennelly's paper, we find Mr. Edison claiming 14 watt-hours per pound of weight of cell, though it is not stated how long this battery had been at work, nor how far the figure was typical of average results.

Contrast with this the figures for eight cells, which, before the date of Dr. Kennelly's paper, had been obtained by M. E. Hospitalier for the Automobile Club of France. The report gives weight and dimensions of cells, and of each part, the number of official charges and discharges, total and average charge and discharge, energy per unit weight, maximum and mean efficiency, &c. The report is now more than two years old, so that the figures are of no great importance, but it is to be expected that competitors for public favour will try to satisfy the need for information in a similarly thorough way. Many questions were asked at the time of Dr. Kennelly's paper as to the exact behaviour of Mr. Edison's cells, and many of the questions remain unanswered. It is also noteworthy that a Norwegian cell—the Jungner—which is similar to Edison's and claims priority over it, has not made headway in the Continental engineering world, although it had attracted considerable attention as early as the beginning of 1901.

According to a writer in a recent number of *Cassier's Magazine*—Mr. Reuterdahl—the nickel cell is older than most of us would imagine: "Nickel was used in storage batteries by Dun as early as 1885, and Desmazure used electrodes of porous nickel in 1887.

"In 1889 Michalowski invented a new process of making nickel electrodes, and was the first to call attention to the thermo-chemical properties of nickel." Pollak and Krieger, both in 1896, brought out cells of iron and nickel respectively. It may be, of course, that Mr. Edison with his wonderful practical insight and large resource may touch these various efforts with the wand of success, though he can hardly be said to have done that with the Edison-Lalande copper oxide-zinc alkali cell.

Mr. Edison does not seem to be well informed as to what has been accomplished on this side of the herring pond with electrically-driven cars.

If the writer is not mistaken the British Electromobile Co. ran a heavy French car a distance of 95 miles on one charge with the Leitner accumulator, and last November the same company ran a light English vehicle 100 miles without recharging, using the A B C (Opperman patent) battery. Since then, it is said, these batteries of a smaller and lighter type have been constantly driving cars for 60 and 70 miles on all sorts of roads without recharging.

Moreover, the Edison battery claims to develop 1 H.P. with 53 lbs. of cells, whereas the A B C accumulator is stated to give

the same result with 44 lbs. of cell. British manufacturers of electro-mobiles contemplate with confidence an early run of 150 miles on one charge of battery.

Still, all must hope that Mr. Edison will succeed. A serious competitor with the lead storage cell would do it no harm. Unless the new-comer has such overwhelming advantage as to force lead right out of the field, it will quicken the mental energy and perhaps increase the mental outlook of those responsible for the creditable performance of the present-day accumulator. But the general interests of electrical engineering will be served by producing definite and reliable data only. If Mr. Edison will but publish these, we shall all feel the advantage.

CORRESPONDENCE.

The Institution and Electrical Legislation.

In reply to Mr. Byng's communication, I believe I may assure him that those engaged in the recent inquiry did not distinguish between the interests of different departments of the industry, which phrase, for want of a better, appears to cover the branches mentioned by Mr. Byng, viz., manufacturing, installing, and working, and that a leading motive was to suggest measures for increasing the scope and improving the openings for electrical engineering.

Whatever other causes may have contributed to the disadvantages under which our electrical manufacturers are labouring, undoubtedly one of the main causes has been the legislative and local hindrances placed in the way of electrical development in this country, to which attention has now been publicly and officially drawn by the Committee's report. The interest of the manufacturer in the removal of restrictions which must tend to limit the number and amount of his order, seems to be obvious, and I hope that Mr. Byng will assist with active support in obtaining reforms.

I am aware that he is an advocate of protection as a means of encouraging the manufacturing side of business, but this is a sectional matter to be dealt with as such, and it should not be allowed to divert our energies from pressing for consideration of the broad questions affecting the whole future of electrical expansion in this country.

Wm. L. Madgen.

Loughborough, *May 30th*, 1902.

Mr. T. C. Elder is really too ingenuous in his line of argument. If we were to imagine such an Utopian state of things as the sudden abolition of all municipal opposition and restrictive legislation to electrical engineering *undertakings*, would the British manufacturer (*i.e.*, the electrical *industry*) obtain all the business which would result? If Mr. T. C. Elder can answer this question in the affirmative, then I will agree that my "inability to recognise the identity of interest" between industries and undertakings is "quite incomprehensible." As a matter of fact, a very large proportion of electrical orders for this country are executed by foreign manufacturers, and if opposition were swept away there is no reason to believe that the proportion of orders which would fall to English manufacturers would increase. I would suggest that Mr. T. C. Elder seeks another cause for the backwardness of our electrical *industries*. There are none so blind as those who will not see, and Mr. T. C. Elder is only one of the few whose eyes are not yet opened.

G. Byng.

London, *May 30th*, 1902.

The Electrical Phenomena Associated with the Volcanic Eruptions in the West Indies.

The Electrical Phenomena associated with the volcanic disturbance in the Islands of Martinique and St. Vincent were so conspicuous as to challenge the attention of everyone. They raised the question, whether or not, the prime cause of the awful disaster is one of an electrical character. If cable reports can be relied upon, it appears that not only were electrical effects noticeable before the Cap of Mont Pelée was blown off, but also during the time of Maximum Eruptive Effect, the almost continuous flashes of lightning (60 per minute) were as fatal to life as the deposited lava and incandescent cinders.*

Animals always give evidence that they are affected by the electrical changes from the normal that precede a thunderstorm. One of the most striking of the phenomena connected with the Martinique disaster was the extraordinary change observable in all the animals living in the island, commencing during the month of April, and continuing up to the time of the occurrence of the eruptions.

Cables state that dogs howled continually, and exhibited every sympton of fear; birds ceased to sing and left the trees on the mountain side; cattle became so uneasy as to be difficult to control; even the snakes crawled from the immediate vicinity of the mountain. Probably some of the more nervous of the inhabitants of St. Pierre may have felt some premonition; highly strung or nervous persons are affected on the approach of a thunderstorm. Mr. Fred. Collins gives a practical proof in the Electrical Review of May 23rd that such a premonition may be caused by Hertzian or other electric wave influences.

Had the Island of St. Martinique possessed a magnetic Observatory similar to that in the Bochum Park, Westphalia, or some other equivalent automatic means of registering the changes of the Atmospheric Electrical Potential, the abnormal conditions that characterise the atmospheric state preceding a volcanic effect would have warned the inhabitants of the once beautiful town to remove to a safe distance.

It is not creditable to science that the simple and comparatively inexpensive instruments for recording the changes in the Electrical Potential of the Atmosphere are not in use in every city of the world. It would be interesting to know if any conspicuous variations were noticeable during the hours corresponding with the period of volcanic activity in any of the Magnetic Observatories. If so, the writer would be glad if the observer could send any data to the editor recording such changes.

Mr. Albert sends a vivid description of what he saw when the eruption commenced. He writes on the morning of the 8th inst.: "The grounds trembled, not like an earthquake, but as if a struggle was going on in the mountain. Suddenly Mount Pelée seemed to shudder; a moaning sound issued from the crater and the air seemed dead. Then I heard a deafening, grinding crashing noise as if every bit of machinery in the world had broken down, and a flash even more blinding than lightning followed. Explosions, sounding as if the navies of the world were engaged in Titanic combat followed, and the lightning played in and out in broad forks, intense darkness being followed by light seemingly of magnifying power. There was no flame in the first wave that descended on St. Pierre."

We realise, therefore, that, weeks prior to the eruption, changes in the Electrical Potential were in evidence on the island, and that the actual eruption also gave evidence of intense electrical effects. The Danish cruiser *Valkyrien* reports that the electrical conditions near Martinique are such that compasses will not work, and navigation is, therefore, dangerous.

The writer, in his series of articles in the Electrical Review of January 21st, March 4th, and April 1st and 8th, 1898, suggested an Electrical Theory to explain the origin of the violent subterranean action that precedes and sustains volcanic eruption effects. The following are examples from the articles:—

> The high intensity (solar) electrical energy, lessened somewhat by producing heat, light, and chemical effects, flows into the earth (the substrata of which constitutes an aqueous agent of electrical energy distribution). The electrical energy is by some internal and inter-molecular influence, and perhaps by resistance, culminating in *internal fusion*.
>
> There is the great absorption of electrical energy in internal and inter-terrestrial *electro-fusion* work, which is always going on, proved by the occurrence of volcanic eruptions, by the increase of temperature in deep borings, and by the contraction of the earth's skin. But it may here be remarked that, although we may by electrical resistance effects raise metal to a state of fusion, it doesn't necessarily imply that the metal is being burnt up, or in any way

* One corpse was found charred from head to foot, brown boots untouched, and a silk handkerchief held in hand unburnt.

altered, and further," under such conditions the additional electrical energy that will be required to maintain the metal in a state of fusion is only that required to compensate for the loss of the heat that flows to that part of the earth that is by its rotation removed from the direct influence of the sun's supply of Electrical Energy.

When the Electrical Solar Energy was initially introduced to the Conductor Planetary Body there would be an immense absorption of Electrical (Solar) Energy in effecting internal fusion work, and at this time all the igneous effects noticed in the shell of the earth and producing contraction of the bulk of the sphere would be then effected.

Assuming the writer's theory to be acceptable, a variation of the Atmospheric Electrical Potential would have an influence on the potential of electrical energy accumulated in the subterranean water, that constitutes in the author's theory the Storage Reservoir and inter-terrestrial distributing centre of Electric Energy, this electrical energy is distributed to the strata beneath it, and eventually reaches the metallic (Day iron) strata which is assumed to be maintained in a state of fusion only, when the potential of current is normal, but if there is a local increase of the potential-electric energy, say, due to the effect of sun-spots, this metal may actually be vapourised by the excessive heat, and immediately such an effect occurred, then an abnormal pressure would certainly be established, which must eventually burst through the Overlapping Strata and produce the Eruptive Phenomena associated with volcanic effect; some of the vapourised (probably iron) metal would escape into the Strata surrounding the active area, and penetrate this Porous Strata where it would be deposited in metallic or oxidised form, *i.e.*, if it came into contact with the subterranean water, and it would be oxidised and deposited in five particles or oxide and redden or discolour the water. We know that in volcanic regions, discoloration of the mineral spring or well water is noticed prior to volcanic or earthquake effects.

Of course, an Eruptive effect must necessarily disturb and eject the Subterranean water, which in contact with the ejected metallic vapour, would produce striking thermo-chemical changes, such as the oxidation of the iron, the production of a ferro silicon, slag, and other metallic oxides, similar to the liquid material that floats on the surface of a bath of steel, in the open hearth or Bessemer Converter, and which is known, geologically, as lava.

Delta.

Electrical Engineers.

The Institution added 538 to their roll of membership last year. Of the making of electrical engineers there is no end—what is to become of them all? It is unfortunately true that for the thousands of young men devoting themselves to the various departments connected with the practical application of electricity there are not many prizes.

Under the generic name of "electrical engineer," all sorts and conditions of men and businesses are included, and the suggestion in our columns last week is not altogether extravagant, that some time in the near future we may find chimney sweeps fixing lightning conductors, and the business of electricity supply, combined with that of *mangling*, which may metaphorically be even now applied in some quarters. A glance through the directories will show how many traders proclaim themselves as electricians and electrical engineers. Of the former, for example, we find that Maple & Co., Limited, and James Shoolbred & Co., have added to their furnishing departments the business of "electricians," while every ironmonger who has accomplished the art and mystery of installing electric bells becomes an "electrical engineer."

In the electrical engineering industry there are, of course, many distinctive branches, but it is a misnomer to classify them all as electrical engineers or electricians. Fancy coupling the names of Lord Kelvin and Sir Blundell Maple as electricians!

Identified with the commercial development of the science, men of various qualifications have naturally come to the front; at first the patient workers in the laboratories, the scientific electrical engineers investigating the properties of the mighty force, and gradually accumulating the data upon which practical action can be taken. Faraday was a type of this class, and then follow the host of inventor electrical engineers, designing methods of utilising the discoveries, manufacturing electrical engineers producing the practical machine and appliances, and with them come the commercial electrical engineers, the financial electrical engineers, working together to create the industry and establish all the subsidiary branches of the business, which require bulky trade catalogues to specify.

The electrical engineer *par excellence* is the man in charge of the central supply station and responsible for the successful working of the complete installation from the generation of the current to its distribution among the users.

The managing director electrical engineer has the most important and delicate duties to perform; his general knowledge in every department must be complete, and the tact and judgment required for dealing with his staff is only possessed by the few. The visitors to a circus have seen the skilful driver of a team of fifty trained horses and marvelled at the precision with which his task is accomplished; but the master knows how to manage his animals, and when to give them their heads, and so obtain the results of their training and intelligence, and so with the clever managing directors.

The openings for the station electrical engineer are necessarily few and their responsibilities are very great, especially in the case of municipal undertakings. In rare instances the remuneration is reasonably good; but as a rule, the pay is altogether inadequate, and the conditions under which they work far from satisfactory.

The Town Councillors can and do interfere, but rarely assist, and in many cases seriously handicap the engineer and his staff.

The satire of your correspondent "U. D. C." is full of truth. The experience of the well-to-do grocer elevated to the position of a member of the Electricity Committee is a fair skit upon the ignorant men who assume to control a municipal electric undertaking and interfere with the only men capable of working it. The position must be almost intolerable to clever young men who have devoted their youthful energies to acquiring a thorough knowledge of their business, and who find themselves, after many years of expensive training, at the mercy of a committee powerful for mischief, but entirely unable to render any real assistance.

The description of the Town Councillor's acquisition of a practical knowledge of the systems of supply, by little trips to the Continent, or distant stations in their own country, is absolutely true to nature, and what a rich field for the operations of the consulting engineer who personally conducts the expeditions like an enterprising tourist's agent, and prepares those "long and valuable reports" with the assistance of the Committee, and which must fill the enterprising municipal traders with such a banquet of ohms, amperes, and volts, that must persuade them that they know all about it, and readily adopt the recommendations of their most talented, genial, and practical consulting engineer, to whom they willingly contribute 5 per cent. on their capital expenditure, without a thought of any personal advantage beyond the proud distinction of having served their town, by preventing private enterprise from introducing the wicked capitalists and their crushing monopolies.

The consulting electrical engineer is, of course, a necessity for the municipality which determines upon supplying electricity, and his occupation is often much less onerous than well paid. He knows that the town councillor, as a rule, cannot very well criticise statements on a subject about which he is profoundly ignorant, and that whether the ultimate results are favourable or otherwise, present success is assured by satisfying the Committees and Councils that the town is securing a valuable asset through the wisdom and farsightedness of the enterprising body he has succeeded in exploiting.

There are eminent men in the profession whose advice would be of great value to local authorities upon the scientific possibilities and probabilities of the proposed undertakings, but these are not the men to whom we refer. We allude to the class about whom Lieut.-Colonel Crompton said in his evidence before the Committee of the Institution, that "it was a matter of common knowledge that a very large number of junior and ill-educated men are acting as consulting engineers, and doing our industry a great deal of harm. Men who left us as pupils, and who were failures in everything,

blossom out into consulting engineers and gradually have a large number of towns to do."

It has been said that the qualification for this class of men is an unlimited capacity for whisky and water, and the constant companionship of a two-foot rule to prove that they are practical men! Their elaborate reports are for the most part copies of a standard form with figures adapted to the size of the installation recommended.

If the works turn out to be unprofitable, the consulting engineer is not responsible; if the plant become obsolete or the system require to be changed, he is ready to renew his valuable service upon the old terms, so that on the whole he has a good time, and may claim to rank as among the most commercially successful of all electrical engineers.

Our remarks apply to undertakings by local authorities; in the case of the companies, the consulting electrical engineer has no happy hunting ground, as they usually comprise in their organisation all the classes of electrical engineers to which we have alluded, including the financial, the commercial, and the technical, which make up the staff of every well-equipped

Electricity Supply Business.

"Scientific Cruelty."

All humane persons must have felt the utmost horror and indignation on reading, in your issue of May 23rd, of the atrociously cruel experiments performed by electricians upon the brain of a living cat, and on seeing the illustration of the torture.

Such deeds of shame discredit and degrade true science, and cause the name of scientist to be associated with animal torture. Cruelty is a crime; *nothing can justify it*, and cruelty to the defenceless is of all crimes the most base, cowardly and revolting; and that those who commit these terrible, fiendishly cruel vivisectional operations, beside which all other forms of cruelty are dwarfed into insignificance, are scientific men, in no way lessens or condones their guilt, or excuses the abominable sin of torturing innocent animals, powerless to resist or protest.

The science of the present day is a pitiless Juggernaut, crushing beneath its gory wheels the mangled, mutilated, quivering bodies of countless thousands of helpless, suffering, tortured creatures, who are equally sensitive with ourselves to pain, who are entrusted to our care, for whose welfare we are responsible, and for our treatment of whom we shall be called upon to answer before God. But higher, greater, nobler, and stronger than this mighty, fashionable, false idol, Science, are right, justice, humanity, mercy, and morality, all of which are grossly outraged by the sickening, hideous cruelty of vivisection.

C. A. M. Bailey.

Guildford, *June 2nd*, 1902.

[While we are pleased to allow our correspondent to give publicity to his views, we must express our disapproval of them, so far as they are opposed to the practice of vivisection, which has been the source of countless blessings to mankind, not the least of which is the avoidance of an immense amount of human suffering. Far be it from us to countenance wanton cruelty, than which nothing is more detestable; scientific research with a definite and useful purpose stands under a different category. Moreover, the animal on whose behalf our correspondent is so solicitous was unconscious throughout the operation, and never recovered consciousness. How, then, could it have suffered? Do human beings suffer when they are operated on under anæsthetics? We must express our thankfulness that scientific progress is not in the hands of such mortals as our correspondent.—EDS. ELEC. REV.]

Water Softening.

Referring to the article in your issue of May 30th, entitled "Water Softening," there are some points in it which require explanation.

For instance, you say in reference to the employment of detartarisers (a name introduced by me when I first commenced the application of my system of purification of water by the employment of heat, and since appropriated by makers of other water-softening appliances) that the benefit is lost unless the water is first passed through the economiser, because it involves deposit in the economiser.

I must confess that I fail to understand what is meant. Where is the advantage of passing the water through the economiser before it reaches the detartarisers? Such a course would be putting the cart before the horse with a vengeance. Evidently the correct method is for the crude make-up to be passed through the detartariser, and thence the softened water should pass to the economiser, where it cannot deposit scale, seeing that its scale-forming properties have been removed in the detartariser.

Again you say, "Where detartarisers are worked by exhaust steam, it is not possible to condense, and the benefit of the economiser is lost where detartarisers work on the continuous system."

There is, however, a number of instances in which detartarisers are working by exhaust steam in condensing stations. You state that by taking one-tenth of the steam from the engine, all the make-up feed water may be heated to 212°, and I wish to point out that by running about one-seventh of the plant non-condensing, not only the make-up, but the entire feed may be raised in my detartariser to 212°, so that not only the advantage of softening the make-up, but also that of the hot feed may be secured. If an economiser is in use it will be kept clean, and so maintained at high efficiency, whilst its life is prolonged, from the fact of its outside surfaces having no tendency to "sweat."

Exhaust from auxiliaries where steam-driven feed pumps, condenser pumps, cooling tower fan engines, economiser engines, &c., are employed is frequently nearly sufficient for operating the detartariser, and the required balance can be made up from the boilers, or, as you suggest, from the receiver of a compound engine.

To refer for a moment to the question of scale in surface condensers, I may mention that about five years ago I erected an evaporative condenser, the tubes of which are still clean and free from scale, the cooling water being softened by detartarisers. The latter serve, as I have described above, for softening the make-up, and heating the whole feed supply to boiling temperature.

I quite agree with your concluding remarks that each case requires to be considered by itself, and it will, I believe, be found that there are few cases in which the employment of detartarisers cannot be combined with the advantages accruing from condensing and flue heating.

William Boby.

[Too narrow a view must not be taken of this subject, and Mr. Boby, of course, writes *ex parte*. While we quite recognise the satisfactory effect of the detartariser, it must not be overlooked that this heats the water so effectually that the efficiency of an economiser must inevitably be very seriously reduced and economy sacrificed. Some economiser makers claim so to scrape the inside of their economiser pipes as wholly to prevent all incrustation, and there is no *primâ facie* case to be made against the apparatus they employ to effect this purpose. The article of May 30th pointed out that one-tenth of the exhaust steam would heat three-fourths of the feed to 212°. This is practically what Mr. Boby claims, for he says one-seventh of the steam will heat the whole of the feed. Now $3 \times 10 = 7 \times 4$ very nearly, so that it is not easy to see where Mr. Boby thinks the fault to lie. The statement in the article was more favourable to the detartariser than Mr. Boby's own remarks. If an economiser is fed at 100° it will not sweat, and there is much to be said in favour of economisers. At the same time there was certainly no intention to do anything but put the various facts briefly before engineers, for, as Mr. Boby admits, every case has its own particular conditions, and it is necessary to weigh these up in order to arrive at the best conclusions. As regards the various exhausts from small engines, these ought to be in some way economised, but we are inclined to think that the best way to do this is by employing electric driving for these small items.—EDS. ELEC. REV.]

A Warning.

Many young electricians have been, and are, signing contracts for work in various parts of South America, in respect of which they think they are perfectly valid so long

as they are stamped at Somerset House, London, and they come out here only to find that they have been "sold." All contracts should be counter-stamped by the Consul-General of whatever country they are going to, and then only will they have any chance of redress if they find them not as represented.

Four young men have come to me during this last fortnight who have been so treated, and who, I am sorry to say, were in very great poverty. I think it only right for this to be made well known, so as to stop any more of these cases. Money *is bad* here, hence most of the trouble.

Engineer.

Chili, *April 20th*, 1902.

LEGAL.

De Dion, Bouton & Co. *v.* Brown Bros.

In the Chancery Division of the High Court of Justice on Thursday last week the plaintiffs in this action applied to Mr. Justice Joyce for an interim injunction to restrain the defendants from selling as De Dion-Bouton, or any description including these names in connection with motors or motor vehicles, any batteries for motors not being plaintiffs' manufacture, and from representing, selling or passing off such batteries as and for goods manufactured by the plaintiffs.

Mr. Hughes, K.C., and Mr. Kerby appeared for the plaintiffs, and Mr. Younger, K.C., and Mr. Hart represented the defendants.

Mr. Hughes said that De Dion-Bouton were well-known names relating to motors, and articles sold under the names were understood by the public to be goods sold by the plaintiffs. The defendants had supplied goods under the name of De Dion which were not manufactured by the plaintiffs. The defence was a curious one. The defendants said they were entitled to supply batteries as De Dion pattern or De Dion imitation because the plaintiffs did not possess a patent. Affidavits filed by the representatives of Mann, Egerton & Co. and the Sheats Trading Co., of Coventry, showed that they applied to the defendants in February and March for "one De Dion battery," and they received batteries which were not those made by the plaintiffs. The learned counsel asked for an injunction to restrain the defendants from using the names in connection with the sale of motors or accessories without clearly distinguishing that they were not the goods of the plaintiffs.

Mr. Younger read an affidavit filed by Mr. Brown, in which he said he had given strict instructions to those in charge of their motor department that no parts not manufactured by the plantiffs were to be sold by the name of De Dion alone. Two batteries had been inadvertently sold under the name of De Dion. It was open to anyone to manufacture and use parts and accessories of the De Dion type, and the defendants had sold, and claimed to be entitled to sell, parts not of the plaintiffs' manufacture under the name of De Dion if they used in addition the words "pattern" or "imitation." If the plaintiffs sought to restrain the use of the name De Dion altogether, notwithstanding that the same was merely descriptive of the type or pattern of the goods, the defendants submitted that it was an attempt to stop a legitimate trade.

Mr. Justice Joyce thought the plaintiffs might be entitled to an injunction to restrain defendants from selling as and for the goods of the plaintiffs' batteries or other goods not manufactured by the plaintiffs.

Mr. Hughes said he would be satisfied with such an order.

Mr. Younger was willing to give an undertaking in the terms of his Lordship's suggestion, and the motion was ordered to stand till the trial on that footing, the costs to be costs in the action.

Fletcher *v.* London United Tramways, Limited.

In the Court of Appeal on Tuesday, the Master of the Rolls and Lords Justices Mathew and Cozens-Hardy, had before them an appeal by Charles Fletcher, from the refusal of the late Judge Bagshawe to award him compensation under the Workmen's Compensation Act for personal injuries sustained while he was in the employment of the London United Tramways, Limited. It raised the question of whether a tramway line was a railroad within the meaning of the Act.

Mr. J. A. Compston who appeared for the appellant, said it was.

The Master of the Rolls said the appeal must be allowed. The workman in this case was engaged in constructing part of a line which came under different statutory provisions at different parts of its length. At one part it was a light railway, and at another it was an electric tramway, or at all events, was not brought under the light railways regulations. The particular part of the system on which the workman was engaged, was known as an electric tramway, and the learned County Court Judge held that having regard to the definition in the Act of Parliament, the workman's case did not come within the Act, and was outside the definition of the word railway. His Lordship saw no reason to differ with the learned judge on that part of the case. The contention, however, was made that if it was not a railway, it was an engineering work, and that the definition of engineering work meant any work of construction, alteration or repair of a railroad, harbour, dock, canal or sewer. There was no presumption that the Legislature in using the words "railway" and "railroad" meant the same thing in both cases. The word railroad was certainly capable of embracing a tramway. In recent times railroad was a word commonly used to describe a tramway worked by horse power. There was nothing which would lead him to infer that the word railroad as a larger term was not used deliberately. The Legislature clearly intended to embrace something outside a railway, because the word railroad was used, and it was placed in the same category as harbours, docks, canals, &c. As the applicant was engaged on engineering work on a railroad, he was entitled to compensation for injury.

Lords Justices Mathew and Cozens-Hardy concurred.

The appeal was accordingly allowed, with costs, and the matter referred back to the County Court to fix compensation.

Mr. Ruegg, K.C., for the respondents, asked for a stay pending appeal to the House of Lords. The case was a most important one, as it meant the inclusion of all tramways within the Act.

Their Lordships refused the application.

The Meyra Electric Company, Limited.

In the Chancery Division on Wednesday last week, before Mr. Justice Buckley, Mr. Abrahams appeared on behalf of Mr. Benjamin Bridgwater in support of a petition for the compulsory winding up of this company. Counsel stated that this was an unopposed petition, but there was a question whether the Court had power to wind up a company where no shares at all had been issued. The company was incorporated in September, 1900. There were seven signatories to the memorandum who each agreed to take one share, but internal dissensions arose, and, in fact, no shares at all were issued.

Mr. Justice Buckley said he did not think the question as to power to wind up need arise. The company had been incorporated, and could be wound up in the usual way.

Mr. Abrahams said the company was formed with a capital of £10,000 for the purpose of acquiring certain galvanic, electric, and other patents, and in particular the Meyra patent. In September, 1901, the petitioner issued a writ against the company for £657 odd, and he ultimately recovered judgment for that sum.

Mr. Holloway, for the company, did not see his way to oppose the petition, and his Lordship made the usual compulsory order.

PARLIAMENTARY.

London United Tramways Bill.

A Select Committee of the House of Commons, presided over by Mr. Compton Rickett, sat on Thursday, 29th ult., to consider the proposals contained in this Bill, which is promoted by the London United Tramways Company.

Mr. Balfour Browne, K.C., opened the case on behalf of the company, and said the Bill was one to enable the London United Tramways Company to construct extensions of their present systems, together with certain widenings and alterations of roads in the counties of London, Middlesex and Surrey. The total length of the company's lines in operation was 16 miles, besides which there were 46 miles authorised. The system was partly worked by electricity. The extensions proposed to be made had a length of 15 miles, and included short lengths in the Hammersmith district to connect the parts of the existing system, one running from Hammersmith to Isleworth with extensions westwards, and the other running from Shepherd's Bush to Southall; a line between Hammersmith and Barnes, Mortlake and Richmond, a line from Wimbledon to Malden, and a line from Wimbledon to Hammersmith along the east side of Wimbledon Common. At present from Richmond to Kew there was a horse tramway in operation, but it had for long been the view of the company, which was now shared by the local authority, that it should be reconstructed and electrically equipped. In connection with that part of the line, important road widenings would have to be effected. Between Mortlake and Barnes the river-side route would be followed, and the company had undertaken to construct an embankment and wall, costing about £30,000, which would be a great public benefit, as it would prevent the flooding that often occurred. Last year an understanding was come to with the L.C.C. in respect to so much of the line as came within the area of jurisdiction, by which the short spur line at Hammersmith should be included in the purchase-powers which would come in operation in 1909, and a protective clause should be inserted for the crossing of the Hammersmith Bridge. It was proposed to carry out these arrangements in the present Bill. That portion of the extensions would entail an expenditure of £158,752 for road widenings and improvements. The company had arrived at an agreement with the Richmond Corporation to construct further important widenings, the Corporation expressing their desire to see the tramway worked by electricity. From the terminus at Malden, the proposed line would be carried in a north-easterly direction to Tooting and Clapham Common. It was intended to expend on the Wimbledon portion of the scheme £180,056 for road widenings and improvements. Opposition was raised to the line by frontagers and by the London & South-Western Railway Company on the ground of competition, which would no doubt arise. On the promoters' line the fare from Richmond to the Bank, *viâ* the Tube railway at Shepherd's Bush, would be only 5d.,

whereas the London & South-Western Railway charged 1s. 3d. third-class. The Committee adjourned.

On resuming on Friday 30th ult., evidence was given by the chairman of the Surrey County Council, Mr. Halsey, in favour of the Bill. Mr. HALSEY said that for many years the subject of tramways had engaged the attention of the County Council of Surrey, and some time ago they resisted an attempt on the part of the London County Council to become a tramway authority within their county. The advisability of the Council constructing tramways themselves had been considered, but there had never been the required two-thirds majority to make the Act operative, and they had come to the conclusion that the next best thing to being the tramway authorities themselves, was to see to it that any tramways within the county were constructed by a responsible company. As the committee were doubtless aware, the Council had supported previous proposals of the London United Tramway Company, and to a considerable extent they were in favour of the linking proposals in the present Bill, as likely to prove of convenience to the travelling public.

Evidence was then tendered by Mr. J. Clifton Robinson, the company's engineer, relative chiefly to the engineering points of the Bill. WITNESS said that the proposed extensions, which were 15 miles in length, would run through the districts of six local authorities who were agreeable to the company's proposals. As to fares, they would be based on those in operation on the company's existing lines, which averaged a little under ½d. a mile for ordinary passengers, and they had entered into agreements with the local authorities by which they would not be able to charge more than ½d. a mile. There were workmen's cars from Southall to Shepherd's Bush between 4 and 7 a.m., for which the fare was only 1d. the whole distance. When their complete system of lines was completed, he estimated they would be carrying some 200 millions of passengers every year. The facilities thus given for rapid and cheap communication with outer London, would go far to relieve the pressure in the crowded districts in and near the centre. The work of construction was proceeding at the rate of about 1½ miles per month, and their wages bill came to about £10,000 a week. He hoped that the line from Isleworth to Twickenham, and well on towards Hampton, would be ready for traffic in about a week's time. Already over their existing 16 miles of tramway in work over 243,000 passengers had been carried in one day, which proved his estimate of the traffic to have been amply justified.

The CHAIRMAN said the Committee had come to the conclusion that they could not consider that part of the Bill which proposed a line from Wimbledon Hill to the point where it was assumed the tramway would connect with the line to Putney, which, although it appeared on the plan, was not yet authorised. He wished to say, however, that the promoters, if they wished, could submit evidence in favour of carrying the line to a point on the top of Wimbledon Hill for the accommodation of passengers wishing to go to the Common. They were not, however, disposed to further consider the continuance of the line beyond the Hill.

Mr. LEWIS COWARD said he had strong local evidence in support of the proposal to carry the line so as to connect with Putney, and he submitted the Committee should have heard him before giving their decision.

The CHAIRMAN said the decision must stand, as the Committee were unanimous on the point. The Committee then adjourned.

On resuming on Tuesday, Mr. PAGE, K.C., intimated that the London and South-Western Railway Company had withdrawn their opposition to the engineering proposals of the Bill after a joint consultation between the respective engineers. They would still, however, appear in opposition to the Bill so far as the question of competition was concerned.

Mr. CLIFTON ROBINSON was then cross-examined at considerable length by various counsel appearing in opposition to the Bill. Witness gave it as his opinion that the tramway would not injure or depreciate property at Wimbledon Hill, while it would enable people to get more easily to the Common. The maximum speed at which the cars would run would be 10 miles an hour, but the speed would be regulated by local circumstances.

Replying to Mr. TALBOT, K.C., for the London County Council, Mr. ROBINSON said it was true that they had consulted Sir Benjamin Baker in reference to the trams going across Hammersmith Bridge. There was no ground for the suggestion that it was because of that that Sir B. Baker had been mentioned as arbitrator in questions arising between the company and the London County Council. He was surprised to hear the County Council contend that Hammersmith Bridge would not bear tramway traffic, because Mr. J. W. Benn, speaking on behalf of the Council, had said that with protective clauses the bridge might be available. They would be willing to insert clauses in the Bill giving the County Council every power as the bridge authority.

Sir DOUGLAS FOX, an alderman of the Surrey County Council, gave evidence in support of the Bill. He said that the Council had frequently discussed the question as to the advisability of themselves becoming the tramway authority for Surrey. He might be said to have taken a prominent part in those discussions. They had never got the necessary majority in favour of that course, and under those conditions he thought that in the public interests it was desirable that all the tramways within the county should be in the hands of one strong company. He had examined the system in operation on the London United Company, and was of opinion that their track, rolling stock and general equipment would compare favourably with any other electric tramway undertaking. He had examined the proposed extensions, and thought they were necessary additions to the lines already authorised. As to the suitability of Hammersmith Bridge for a tramway, he should say that the main structure of the bridge would be quite strong enough to carry the cars, but in order to prevent oscillation, the platforms might require cross bracing. He thought that it would be advisable to limit the number of cars that might be on the main span of the bridge at any time. His experience was that tramway extensions were serviceable to railway companies, as they acted as feeders to them, and therefore he thought that the opposition of the South-Western Railway to this Bill was ill-advised, even in their own interests. The Committee adjourned.

LORD WINDSOR'S TUBE COMMITTEE.

ON Friday, 30th ult., the Select Committee of the House of Lords on London Underground Railways, presided over by Lord Windsor, reassembled to consider compensation clauses to be inserted in the tube Bills passed by both that Committee and Lord Ribblesdale's Committee.

Mr. BALFOUR BROWNE, K.C., on behalf of the Piccadilly and City and London United Electric Railways Companies, said his clause provided: "That if any building shall have been injuriously affected either by the construction of the railway or works or by working of the railway, any owner or lessee of such building shall be entitled to recover from the company compensation for any such damage proved to have been actually caused to such building, and that any question of disputed compensation should be determined by an arbitrator, who, failing agreement, was to be appointed by the President of the Surveyors' Institution."

Mr. LITTLER, K.C., submitted a clause on behalf of the Brompton and Piccadilly Circus Railway very similar to that of Mr. Balfour Browne, with the exception that, failing agreement, the arbitrator was to be named by the Board of Trade. The clause also provided that the railway company should have the right to go in and remedy any injury caused by the construction of the line as quickly as possible without waiting for the Court of Arbitration.

Lord ROBERT CECIL, K.C., on behalf of the landowners, said his clause provided that in addition to the provisions incorporated in the Act with respect to compensation, "the company shall make compensation for all damage or loss of every description which may be caused to the owner, lessee or occupier of any lands, house or building by reason of the working of the railway, including the working of lifts and any other works in connection with the said railway, notwithstanding that no part of the property of such owner, lessee or occupier is actually taken by the company, provided that all claims for compensation under this section shall be made within three years from the date of the opening of the railway for public traffic.

Mr. PEMBER, K.C., said what was required in that clause was phraseology sufficiently broad and comprehensive to meet the difficulties that tube railways had caused or would cause.

The clause was opposed both by Mr. Littler and Mr. Balfour Browne on the ground that its adoption would prevent any tube railway being constructed in London. The Committee adjourned.

The Select Committee met again on Tuesday last, when further consideration was given to compensation clauses.

Lord ROBT. CECIL, K.C., on behalf of the landowners, said upon the suggestion made by Lord Knutsford, they had made certain alterations in their clause, and it now read: "In addition to the provisions incorporated herewith, with respect to compensation for land taken or injuriously affected, the company shall make compensation to the owner, lessee, or occupier of any land, house, or building which shall be injuriously affected by reason of the working of the railway (including the working of lifts and any other works in connection with the said railway), notwithstanding that no part of the property of such owner, lessee, or occupier is taken by the company, as fully and to the same extent as if a part of his property had been taken by the company. Provided that all claims for compensation under this section shall be made within three years from the date of the opening of the railway for public traffic, and the provisions of the said incorporated Acts with respect to the settlement by arbitration of questions of disputed compensation shall extend and apply to, and in the case of, any such claim, save that the amount of compensation payable by the company shall, if not agreed upon, be settled by a single arbitrator to be agreed upon by the parties, or, failing agreement, to be appointed by the Board of Trade. (2) An arbitrator under this section may, to the consent of all parties concerned, hear together any class or group of claims under this section." They had taken the words "for all damage or loss of every description which may be caused" from the original clause.

Mr. Pember, K.C., Mr. Ram, K.C., and Mr. Rigg, on behalf of their clients, expressed their approval of the amended clause.

After the Committee had consulted in private, the CHAIRMAN announced that it was decided to proceed on the basis of the last clause brought forward by Lord R. Cecil. They proposed to take the clause as it was drafted down to the word "railway," when they wished to make it clear that they intended to make that apply to the railway so far as it was constructed in tunnel and not to apply to the continuation of the line in the open. The period for making claims would be two years instead of three years, as stated in the clause. The remainder of the clause down to the words "Board of Trade" would keep as it was, and it was proposed to insert there the words "and subject as aforesaid all the provisions of the Arbitration Act of 1889 shall apply to every such arbitration."

Lord RIBBLESDALE said by the courtesy of Lord Windsor he had been allowed to sit on that Committee, and he fully concurred with the clauses laid down, and he wished it to be understood that the

conditions be attached to the Bills which had been passed by his Committee were subject to the insertion of that clause.

The Committee then proceeded to consider certain protective clauses in regard to buildings affected by the Piccadilly and City Railway, after which the Committee adjourned.

Manchester Corporation Bill.

A Select Committee of the House of Commons, presided over by Mr. Bell on Monday and Tuesday, considered the Manchester Corporation (General Powers) Bill, which confers various powers on the Corporation with reference to the construction of railway and other works in connection with the electricity undertaking. In the Bill it is proposed that the Corporation shall have power to borrow £75,000 in connection with the electricity works.

Mr. Balfour Browne, K.C., who appeared for the promoters, said a controversy had arisen between the various railway companies and the Corporation with regard to the proposed borrowing for the electricity undertaking and the widening of streets. With regard to the first matter, the Corporation proposed to make sidings in connection with their works on the Lancashire and Yorkshire Railway Company's line. The generating station would be a large one, and the great bulk of the coal used would doubtless be conveyed by that line. The railway companies were not opposing to reject the Bill, but to be exempt from the rates they would otherwise be subject to. He contended that the railway companies were asking the Committee to alter the general law in their favour, and this he objected to.

After hearing evidence, the Committee decided to allow a partial exemption from rating asked for by the railway companies in respect of street improvements, their decision being founded on precedent in the case of Manchester.

Mr. De Courcey Mead, the city surveyor, explained the work proposed to be carried out with respect to the Stuart Street generating station, which would cost £75,000.

Mr. Metzger, the electrical engineer, gave evidence as to the need of the Stuart Street works. In the past year there had been an increased consumption of 3½ million units as compared with the previous year.

The Committee passed the clauses dealing with the generating station works and passed on to other provisions not of an electrical nature.

Electric Light Provisional Orders Bill (*No.* 8).—Standing Orders were found to have been proved in the case of the above Bill on Tuesday. The Bill confirms Electric Lighting Orders granted by the Board of Trade in respect of the following districts:—Bermondsey and Rotherhithe; Stoke Newington; Woolwich.

Tramways Orders Confirmation Bill (*No.* 1).—The Tramway Orders Confirmation Bill, No. 1, which confirms certain provisional orders made by the Board of Trade under the Tramways Act, 1870, passed the Examiner of Standing Orders in the House of Lords on Tuesday. The Bill confirms orders in respect of the following places:—Brighton; Cheadle and Gatley; Lees; Southport; Stockport; Sunderland.

Electric Light Provisional Orders Bill (*No.* 7).—The above Bill, which confirms orders granted by the Board of Trade under the Electric Lighting Acts, was before the Examiner of the House of Lords on Tuesday, and Standing Orders were found to have been complied with. The following areas are affected:—Bedlingtonshire; Chepstow; Cowes; Hitchin; Morpeth, Ashington, Newbiggin-by-the-Sea, and Morpeth (rural); Pokesdown; Slough; Stevenage; Tadcaster and District; Trefriw; West Riding.

Metropolitan Railway Bill.—On Thursday last week the Court of Referees in the House of Commons heard the application of the London County Council for a *locus standi* to be heard against the Metropolitan Railway Bill. The contention of the Council was that the company should be placed under statutory obligation to widen Marylebone Road and Allsopp Place, and to construct the frontage of and the entrance to the station according to plans to be approved by them. The Court disallowed the application.

Tramways Orders Confirmation Bill (No. 2).—The above Bill which confirms certain provisional orders made by the Board of Trade under the Tramways Act, 1870, has passed the Examiners of the House of Lords. The Bill deals with the following localities:—Heywood; Leeds; Pontypridd; Southampton; West Riding; Wolverhampton.

City and Brixton Railway.—This Bill came on Thursday last week before the Chairman of Ways and Means in the House of Commons as an unopposed measure, when the necessary proof was given, and the Bill was ordered to be reported for third reading.

Ashton and Dukinfield Corporations Bill.—On Thursday last week this Bill came before the Chairman of Ways and Means in the House of Commons as an unopposed measure, and was ordered to be reported for third reading.

Finchley Improvement Bill.—This Bill came before the Chairman of Ways and Means of the House of Commons as an unopposed measure on Tuesday, and was ordered to be reported to the House. Powers are given under the Bill for the Urban District Council to erect a generating station on certain lands, and an extension of time is given for the laying of mains in certain areas.

Abertillery Urban District Council.—On Tuesday the Abertillery Urban District Council Bill was before the Chairman of Ways and Means in the House of Commons as an unopposed measure, and was ordered to be reported for third reading. Further provision is made in the Bill with regard to the supply of electricity, the estimated expenditure under this head being £50,500.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Inquisitive" writes:—"I should be glad if you would kindly advise me through the medium of your "Legal Column" on the following points:—

"1. On reading a prepayment meter fixed in a consumer's house, it is found that the units consumed exceed those for which prepayment has been made. Can the consumer be compelled to make up the difference? Or, supposing the balance to be the other way, must the lighting authority refund any money overpaid?

"2. There is a type of prepayment meter which has no cut-off, but simply switches in a resistance after the quantity paid for has been taken. Would question (1) be affected by a consumer getting a lower voltage lamp and running on the dimming device without putting any more money in?

"3. If a house has been 'free' wired and a slot meter installed which is arranged to charge a sum per unit to cover rental of wiring and fittings, and a new occupier insists on the prepayment meter being taken away and an ordinary meter substituted, (*a*) May the company remove the wiring and fittings against the tenant's wish? (*b*) If not, may the tenant make use of the wiring and fittings without paying a rental for them? (*c*) Can the consumer insist on the wiring and fittings being removed and substitute his own in place of them?

"4. If a motor meter with zinc case is put in a consumer's premises, and the consumer places a mass of iron or a magnet near the meter so as to affect its working, would this legally constitute tampering with the meter; and would this question be affected if the consumer did so without any intention of defrauding the company?

"There is a great difference of opinion among central station engineers on the above points, and I think your advice would be of general interest."

*** It is no easy task to furnish wholly satisfactory answers to the questions put by our correspondent, for the reason that the Electric Lighting Acts lay down no special provisions which are applicable to different kinds of meters. Nevertheless, the following replies to his various queries may be found useful:—

(1) It is a little difficult to answer this question without a more exact definition of the term "prepayment meter." It is assumed, however, that this type of meter is worked on the principle, that upon the prepayment of a certain sum the consumer is entitled to a fixed number of units. Our correspondent finds, however, that when the supply is automatically switched off in the machine the dial registers a larger number than was contracted for. In such circumstances we think that the consumer could be called upon to pay the excess, and that in the converse case the company could be made to refund the money. It is obvious that in the first case the consumer will have had the use and benefit of the additional units; in the second, he will not have had full value for the sum of money which he has paid in.

(2) With regard to this question, we fail to see what bearing it can have upon number (1). If the company have so arranged their slot meter that at the conclusion of the run the current is partially but not wholly cut off, it would seem that the use of a partial current in perpetuity is legitimate, and is part of the consideration for which the 1d. is paid. But is our correspondent quoting from his own knowledge when he says there are meters in use which can be so easily tampered with?

Generally, with regard to questions (1) and (2), we would refer to Clause 57 of the schedule to the Electric Lighting (Clauses) Act, 1899, which provides for the manner in which disputes between company and consumer on the question of meter registers are to be settled.

(3) (*a*) Undertakers are allowed to demand payment for a meter from a consumer before putting it in (El. L. Cl. A., 1899, S. 52), and this rule applies whether there is a meter there already or no.

(3) (*b*) and 3 (*c*). It is impossible to answer either of these questions without having access to the terms of the agreement between the company and the "slot consumer" who had taken the free wiring agreement.

(4) The voice of conscience provides a ready answer to this question, and our correspondent seems to acknowledge this in his proviso. The Statute (10 and 11 Vict., c. 15., S. 38, incorporated with 62 and 63 Vict., c. 19) provides that:—

"Every person who wilfully, fraudulently, or by culpable negligence injures, or suffers to be injured, any . . . . meter, ... or alters the index to any meter, or prevents any meter from duly registering the quantity of electricity supplied, shall, &c., forfeit and pay, &c. . . . ." It is presumed that any electrical engineer who erected a Ferranti or other meter in the neighbourhood of a large dynamo or other machine fitted with electro-magnets would be guilty of such culpable negligence as to bring him within this section.

Newstead.—The ratepayers have decided to have the streets lit by electricity from the plant at the colliery. The cost will not exceed 1d. per week per house.

THE ESCAPE OF ELECTRICITY.

(By Our Legal Contributor.)

Much has been said and written about the disastrous consequences which result from the electrolytic action of escaping currents upon gas and water pipes; and it seems to be generally accepted, without any authority for the proposition being cited, that, in such cases, those who allow the current to escape are, *ex hypothesi*, liable to make good the damage. No authority is ever quoted, for the excellent reason that there is none. Parliament has never, except in the case of the Sheffield Corporation Tramways Bill, decreed that tramway companies or other bodies who make use of powerful currents of electricity shall be held liable if that electricity escapes and does damage.

It is true that clauses are inserted in private Acts which authorise the use of electricity, providing that nothing in the particular Act shall excuse the company from liability for negligence. In other words, no statute ever takes away their liability for negligence at common law.

What, then, is the nature and extent of this common law liability? The recent case of the Eastern and South African Telegraph Company, Limited, *v.* the Cape Town Tramway Company, Limited, in which judgment was delivered by the Judicial Committee of the Privy Council on April 21st, sheds a flood of light on this question.

The history of this case was shortly as follows:—

The plaintiff company are the proprietors of (*inter alia*) the West Coast cable, which runs into the sea near Cape Town, and lies on the sea floor in Table Bay. The defendants are the proprietors of the Cape Town tramways, which are worked electrically by the trolley system, the current returning through uninsulated tramlines. The defendants work the greater part of their system under statutory powers, but there is one portion, in respect of which they have no statutory or other authority to work the trams electrically, with the exception that the highway authorities have granted them permission to use the roads for the purpose of laying tramlines and erecting posts for the support of the overhead wire.

It will be convenient to refer to this portion of the defendants' undertaking as "the unauthorised section." As soon as the defendants commenced to run their trams by electricity, it was found that currents were induced in that portion of the plaintiffs' telegraphic cable which runs under the sea in Table Bay to such an extent, that it was almost impossible to receive intelligible messages. It appears that currents of electricity escaped from the tramrails, and entered the sheathing of the telegraphic cable. Flowing along this sheathing they induced currents in the conducting wire of the cables. The real cause of the mischief was the stopping and starting of the tramcars which caused irregularity in the current. Experiments were made both by the plaintiffs and the defendants in order to remedy the mischief, and it was eventually found that by laying what is called a twin-core cable for some miles out to sea, the mischief could be almost entirely obviated. Steps having been taken in this direction, the plaintiffs brought an action against the defendants, claiming an injunction to restrain the tramway company from so conducting their business as to cause injury to the working of the telegraphic cable, and also claiming damages which were based upon the cost of supplying the twin-core cable. The defendants relied upon their statutory authority to generate electricity to protect them from having to pay damages for injury done by escaping electricity, and with regard to any electricity which might have escaped from the unauthorised section, they claimed that there was no principle of common law upon which they could be held responsible. The plaintiffs, on the other hand, relied on the case of Fletcher *v.* Rylands, L.R. 3 H.L.C. 330, where it was decided that if a man brings anything on to his land of a dangerous character, and that thing escapes and does injury to a neighbour's property, the owner of the dangerous thing must be held liable in damages. In that case a man had built a dam, and so accumulated a large quantity of water. This escaped and flooded some neighbouring property, and the owner of the dam had to pay damages. In accordance with this decision, it was argued by the plaintiffs in the case under review that escaping electricity came within the same category, and that, although the defendants might have been protected by statute in respect of the greater part of their system, yet some of the electricity which did the damage must have escaped from the unauthorised portion. The action was originally brought in the High Court of Cape Town. The Court of First Instance and the Court of Appeal at the Cape both found in favour of the defendants, and, on appeal to the Privy Council, their Lordships have affirmed that decision. It is not necessary to set out the judgment of the Court, which was delivered by Lord Robertson, at any length, but it was clearly laid down that, although the principle of Fletcher *v.* Rylands is applicable to the storage of electricity in the quantity in which the tramway company stored it, yet there was no such resulting loss caused thereby to the telegraph company as was contemplated by that case. It was also decided that the mere fact of electricity escaping is not *primâ facie* evidence of negligence; that when it is said that a man shall be held liable for injury to his neighbour's land it is meant that he must not interfere with the natural use of his neighbour's land, *i.e.*, that neighbour has no right to claim protection for all the extraordinary uses to which he may feel inclined to put his land. To put this doctrine a little more plainly, the Privy Council has held that if a man makes use of delicate instruments which may possibly be affected by stray electric currents in the earth, he is bound to take every precaution to prevent such instruments being injuriously affected. So, in the case under notice, it was shown that when the twin core cable was adopted, the nuisance ceased. Hence the telegraph company were taken to have always had it in their power by the exercise of reasonable care to keep off the induced currents.

Unfortunately decisions of the Privy Council are not binding upon our English Courts: partly for the reason that they are based upon the law as administered by the various Colonial courts of the Empire. They are, nevertheless, regarded with great respect, and we trust that the decision in the Eastern Telegraph case which expressly recognises, but at the same time limits, the doctrine of Fletcher *v.* Rylands will be adopted in this country. If so, let us see what the result will be. An action is brought to recover damages for interference with a telephone system caused by the fact that a tramway company in common with the telephone company, use the earth for their return currents. It is proved at the trial that if the telephone company had adopted the double-wire system, no injury could have been done. In such a case, if the reasoning of the Privy Council be adopted, the tramway company will be entitled to judgment; but according to the law at present in force in this country, unless a tramway company are working under some Act which gives them a right, expressed or implied, to discharge electricity into the earth they may be held liable.

Making a similar assumption as to the effect of the decision of the Privy Council, any action brought to recover damages for the result of electrolysis may be met by a similar defence—namely, that the water or gas company has not taken the proper steps to prevent the access of stray currents to the metal. Such precautions would probably include the proper drainage of the soil in the neighbourhood of the pipes, and in the case of water pipes the prevention of leaks from the joints.

REVIEWS.

The Indicator Handbook. Part II. By Charles N. Pickworth. Manchester: Emmott & Co. 3s. net.

This is a sequel to the author's book on the construction and application of the indicator as an instrument, and is devoted to the consideration of the diagram taken by that instrument and the teachings of that diagram. In it will be found sufficiently theoretical explanations of the expansion curves and other lines of the steam diagram. We say sufficiently theoretical because it is not possible to apply, with

any satisfaction, too close a theoretical reasoning to the lines of action of a fluid which is by no means a perfect gas, and is working in a vessel by no means adiabatic or isothermal. The ordinary expansion curve of a good engine will usually rise above the hyperbola, but the expansion curve of steam always should fall below that curve of comparison. Departures above or below the hyperbola simply measure the mean effects of condensation, piston leakage or valve leakage, and practice alone can enable the engineer to trace out causes. In this part of the book the author shows that he knows whereof he speaks. He also gives a useful table of terminal pressure factors for saturated and adiabatic curves from 1 to 30 expansions, calculated on the basis of the fractional indices $\frac{1}{16}$ and $\frac{1}{10}$, as given by Rankine.

The diagram is considered in detail in Chapter II., each of the four so-called "lines" being taken separately. This is well done, and includes a table of low-temperature vapour pressures for use in questions of condensation. Some useful notes, are made on the action of air pumps. Diagram analysis continues through the next chapter, and Chapter IV. deals with compound diagrams and the method of combining these for comparison.

In Chapter V. the gas engine diagram is dealt with. The gas engine differs widely from the steam engine. In the latter we at least attempt to keep the cylinder up to the temperature of the fluid that enters it. True, we do not usually attain to this high aim, but the necessity or desirability of this is recognised. In the gas engine, with a working fluid many times hotter than steam, we deliberately circulate cold, or merely warm, water, about the working cylinder, and in spite of this we secure better results, referred to the fuel, than we can secure with steam engines referred to the same basis, and this, too, though we throw away our gas exhaust at a high temperature and pressure. The author does not tread so firmly over the gas diagram as he did about the steam engine. He leaves his reader to apportion the departures of the expansion curve from what it might be to a variety of causes. It is even hinted that the cylinder wall may cause the rise of the expansion curve towards the "toe." We doubt any serious wall action unless this be held to include the unjacketted piston. Probably the face of this, heated by the initial explosion, does radiate considerable heat into the mass of gas behind it, but surely this effect must be more than balanced by the water-cooled wall. After-burning is appealed to. Here, again, we think that too much is allowed for dissociation. In one place alone is the possibility alluded to of "suggested" increase of specific heat. We thought that no doubt now existed as to this fact, and that the results attributed to delayed combustion were more probably to be set down to the setting free of heat latent at the high temperatures of the initial explosion.

A final chapter is added on air-compressor diagrams. The pernicious influence of clearance spaces is pointed out, and the benefits to be secured from the filling of these with circulating oil in a certain type of ammonia compressor are described. Planimeters are also described, and various diagram calculations are given.

In an Appendix is given a method of graphically determining the index of any curve of expansion or compression. The book is a plain treatise on its subject, which we are pleased to recommend. It is slightly marred by an unusually plentiful crop of "and which," and split infinitives.

BUSINESS NOTES.

Niagara.—Up to the early part of 1900 the capital stock of the Niagara Falls Power Company was $3,500,000, and then it was increased to $6,500.000. Only two years have passed since then, and now comes an announcement that the stockholders will immediately hold a special meeting at Niagara Falls for the purpose of increasing the capital stock from $6,500,000, consisting of $65,000 shares at $100 each par value, to $9,500,000, to consist of 95,000 shares of the par value of $100 each. This capital stock of $9,500,000 has nothing to do with the millions of dollars that will also be expended on the Canadian side of Niagara. On both sides of the river great power works are in progress.

Electrical Wares Exported.

WEEK ENDING JUNE 4TH, 1901.		WEEK ENDING JUNE 3RD, 1902.	
Adelaide	Value £193	Adelaide	Value £594
Aden. Teleg. cable ..	108,520	Amsterdam	23
Alexandria	131	Azores. Teleg. instruments ..	150
Amsterdam	117	Beira. Teleg. mat.	241
Bangkok	227	Bombay. Teleg. instruments ..	650
,, Teleg. cable	1,646	Calcutta	726
Beira. Telephones	17	,, Teleg. wire	8,625
Brisbane	36	Cape Town	15
Buenos Ayres	475	Channel Islands	105
,, Teleg. mat. ..	639	Colombo	49
Calcutta	416	,, Teleg. mat.	32
Callao. Teleg. cable	975	Copenhagen. Teleg. wire ..	11
Cape Town	73	Corfu. Teleg. mat.	47
,, Teleg. mat. ..	21	Durban	2,113
Copenhagen. Teleg. wire ..	184	Fremantle	819
Durban	1,151	Gibraltar. Teleg. mat.	184
,, Teleg mat.	1,862	Halifax	40
Fremantle	1,968	Lyttleton	51
,, Teleg. cable ..	819	Madras	50
,, Teleg. mat. ..	21	Maryborough	87
Gibraltar. Teleg. apparatus ..	60	Melbourne	650
Halifax. Teleg. cable	3,000	Nagasaki	636
Hamburg	50	Port Elizabeth	104
,, Teleg. mat.	380	Port Said	37
Hiogo	32	Rockhampton	51
Hong Kong	84	St. Petersburg. Teleg. cable ..	69
Kure. Teleg. cable	1,088	Shanghai	228
Lisbon	150	Singapore	81
Madras	10	Sydney	122
Malta	60	Vera Cruz	4,798
,, Teleg. mat.	60	Wellington	90
Melbourne	786		
Nagasaki	51		
New York	384		
Odessa	75		
Oporto	15		
Ostend	173		
Santa Cruz	91		
Shanghai	120		
,, 75 tons teleg. wire ..	—		
Singapore	29		
Sydney	571		
,, Teleg. wire	770		
Valparaiso	167		
Vigo. Teleg. mat.	58		
Wellington	1,326		
Total ..	£129,036	Total ..	£20,877

Foreign Goods Transhipped.

Brisbane. Teleg. apparatus Value	£638	Gothenburg. Elec. appar. Value	£40
Durban. 80 cwt. teleph. wire ..	—	Sydney. Elec. lamps	120
Fremantle. Elec. machinery ..	1,804		
Total	£2,442	Total	£160

Austrian Exhibition.—We understand that the whole of the incandescent lamps supplied to the Austrian Fine Art and Decorative Furnishing Exhibition, at Prince's Skating Rink, Knightsbridge, which was opened on Monday last week, were made by the "Watt" factory, of Vienna, for whom Messrs. De Grelle Houdret & Co. act as agents for this country.

Books Received.—"Electrical Installations of Electric Light, Power, Traction, and Industrial Electrical Machinery," Vol. I., by Rankin Kennedy. London: The Caxton Publishing Co. 9s. net.

"Deep-Sea Sounding in the Pacific, May to August, 1901," by R. E. Peake.

"The application of Electric Motors to Machine Driving," by A. Stewart. Second Edition. London: S. Rentell & Co., Limited. 1s.

Catalogues, Lists, &c.—Messrs. John Fowler & Co. (Leeds), Limited, are sending out a neat show card of Wilkinson's patent street transformer pillar and lamp standard combined.

Messrs. Ferranti, Ltd., of Hollinwood, have sent us a copy of their excellent Wolverhampton Exhibition pamphlet (No. 151), which gives full particulars of the Ferranti medium speed engines of standard sizes from 300 to 3,000 KW. There is an imposing list of electric lighting and traction stations where these engines are employed, showing their growing popularity. One of the illustrations shows a 650-H.P. engine with traction dynamo, as installed for the City and South London Railway Company; others show a 2,000-H.P. compound engine with single-phase alternator, and a 650-H.P. engine and multiphase alternator.

Messrs. H. V. Kramer & Co. have sent us a leaflet and particulars of their small continuous current motors.

A pamphlet has come to hand from the Edison & Swan United Electric Light Co., Ltd., illustrating and describing their various fan motors.

From the "Buffoline" Noiseless Gear Company, of Levenshulme, we have received a new list of their toothed gearing for electric motor, haulage, pumping, motor car and other machinery.

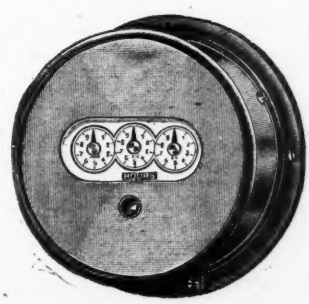
Messrs. R. W. Blackwell & Co., Ltd., of City Road, E.C., have just issued a new catalogue (No. 46) in which the "Standard" and "Universal" electric motors and generators are detailed, also linotype geared motors, desk and ventilating fans, dynamo brushes, &c.

Car Driver Summoned.—At Margate on Wednesday last week, Geo. Mercer, a motor man in the employ of the Isle of Thanet Electric Light and Traction Company, Limited, was summoned for driving a car at a speed of 3¾ miles an hour instead of 2 miles an hour, the Board of Trade limit, down a steep hill known as Fort Road. The facts were admitted, but for the defence, Mr. Shea, solicitor, urged that the Board of Trade regulations were not to be slavishly adhered to. The evidence of the police showed that the driver had the car under absolute control. The instructions to the drivers were that they should use the electric brake when

descending the hill in question, with the hand brake just on the rim of the wheel in case of emergency. The car must be travelling at some little rate of speed in order to make the electric brake act efficiently, and when the rails were wet, as on this occasion, the electric brake would be inoperative if the tram was running at only 2 miles an hour, while if the hand brake was used with greater power, the wheels would lock and the car would become unmanageable, run down the hill, and probably cause an accident. The driver in his evidence bore out Mr. Shea's statement, and the Mayor (Mr. J. Hosking) who is an engineer, stated that 2 miles an hour would be safe to run down a hill on a dry day but not when the rails were wet. The manager of the company (Mr. R. Humphreys) said that the Board of Trade did not make any inspection of the line when the weather was wet. In his opinion, the driver exercised sound discretion in descending the hill at 3¾ miles an hour. The Mayor announced that by a majority the Bench decided to convict, and a fine of £5 and 9s. costs would be imposed.

Coronation Arrangements. — The directors of the Robertson Lamp Company have offered their workpeople's large dining hall for the use of the King's Dinner Committee for Hammersmith, of which offer the committee have been pleased to avail themselves, as the dining hall is the largest in the district. The directors have also decided to pay their workpeople two days' full wages for the two Coronation holidays, in commemoration of the coronation of King Edward VII., and as a recognition of the efforts of the workpeople during an excessively busy and trying period.

Current Duration Counter. — The accompanying illustration shows an instrument now being supplied by Messrs. O. Berend & Co., Limited, for gauging the amount of energy used in any electric light or power installation where the number of lamps, alight at the same moment, or the power taken by any motor, is approximately constant. In installations where only a small amount of energy is annually consumed, the cost of installing a watt-hour-meter and of periodically testing it, bears a considerable ratio to the cost of the energy itself, and in such cases the current duration counter may be advantageously substituted. The instrument consists of a 300-hour anti-magnetic clock, provided with an



electrically-operated starting and arresting device. It is made in two forms—one for small and the other for large currents. In the former, the instrument is connected in series, and in the latter in parallel with the mains. The series type starts with a current of about $\frac{1}{10}$th ampere and stops when the current falls below this value. The parallel type starts or stops the instant the motor or lamp circuit is closed or opened respectively. The clock requires winding up about once a month, and the figures on the dial represent the number of hours during which any current has been taken from the circuit to which the instrument is connected.

Dissolutions and Liquidations.—Creditors of the Gateshead Electric and Mechanical Supply Company, Limited, should send particulars of debts, &c., to W. T. Price, 21, Collinwood Street, Newcastle-upon-Tyne, liquidator, by June 24th.

A meeting of the Commercial Telegraph Construction Syndicate is to be held at 7, Angel Court, E.C., on July 15th, to hear an account of the liquidation proceedings from C. Quennell, liquidator.

At an extraordinary general meeting on 21st ult., Messrs. Morgan, Mondey & Co., Ltd., electrical engineers, Rotherham, resolved to voluntarily wind up their affairs, and appointed as liquidator Mr. H. J. Allen, of St. Peter's Close, Sheffield, to whom all accounts should be forwarded.

Electro-chemical Factory in Italy.—The Italian Office of Public Works has definitely approved an important project having for its object the installation of a factory for the electrolytic manufacture of soda and other chemicals. The concession has been secured by the Italian Electro-Chemical Company (Société Italiana di Elettrochimica), of Rome. A hydraulic installation with a head of water of 70 metres will be utilised, giving about 8,300 H.P.

New Starting Switches.—We illustrate herewith a new line of starting and regulating switches which the International Electrical Engineering Company, of Clun House, W.C., are placing on the market. Figs. 1 and 2 show starting and regulating switches each fitted with "no voltage" release. Fig. 3 is a starting switch having "no voltage" release suitable for large currents, the contacts being of large area and renewable. For switching off automatically in case of an overload, the switches are fitted with a relay to demagnetise the retaining coil. The switches can also be supplied with protective covers to prevent accidental shock, and when desired they are also enclosed in cast-iron cases suitable for use in collieries and exposed positions. A novel feature of the switches consists in the extremely simple means for retaining the switch arm magnetically in the "full-on" position, in a starting

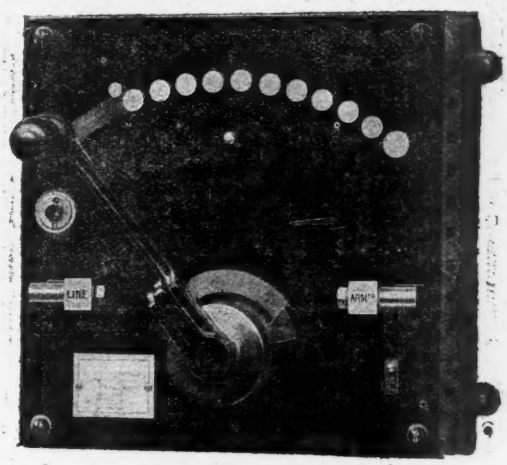


Fig. 1.—Starting Switch.

switch, or on any desired contact in a regulating switch. It consists in winding the retaining coil upon an iron bobbin forming the bearing of the switch spindle, thus obtaining a closed magnetic circuit through the spindle and a part of the switch arm to the back flange of the bearing bobbin, the parts being made of soft iron. The number of contacts of all the switches is ample, and it may be mentioned that in no case is the switch rated for greater horse-power at the higher voltages, merely because the current density at the contacts is reduced. All the starting switches are arranged to short-circuit the starting resistance in the shunt circuit when in the "full on" position, and if desired a separate shunt contact strip is fitted to ensure the full voltage to the motor field magnets at all positions of the switch arm. Regulation of the spring can be effected from the front of the switch in the smaller sizes by inserting a screwdriver in the screw at the end of the spindle, and holding the spindle, whilst the pin fixing the switch arm to the spindle is removed. The spindle can then be turned until the torsion of the

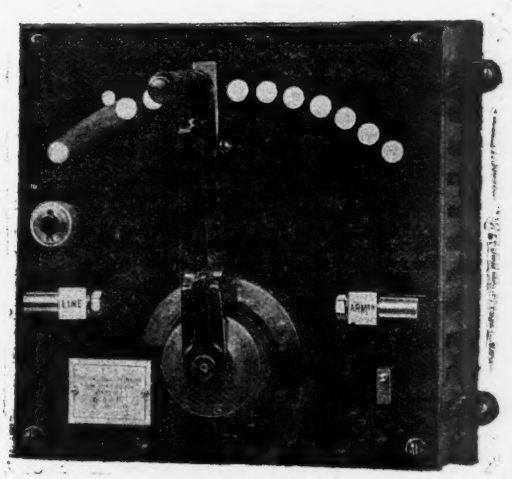


Fig. 2.—Regulating Switch.

spring is suitable, and the pin replaced. Every care is taken with the insulation of the apparatus. The slate is specially insulated from the iron frame, and the resistance coils are wound on asbestos tubes carried on porcelain insulators. Every switch box has an earth wire screw. The connecting wires between the switch contacts and the resistances are held in definite positions by a clamp to ensure against accidental short-circuits. This arrangement, and the method by which the wires are connected, enables the switch to be readily separated from the resistance if desired. Before leaving the works every switch is tested with an alternating current at 2,000 volts. The company aim at supplying apparatus which will give permanent satisfaction, and with this in view they have been most liberal in proportions, and every care is taken to ensure simplicity along with good mechanical construction. Every part of the apparatus can be readily taken to pieces for repair, renewal, inspection, or adjustment, and easily replaced. The switches are

made in the works of the firm at Liège which are amongst the best equipped in Europe, and by strict standardising and employing the most modern processes for cheapening production, the company

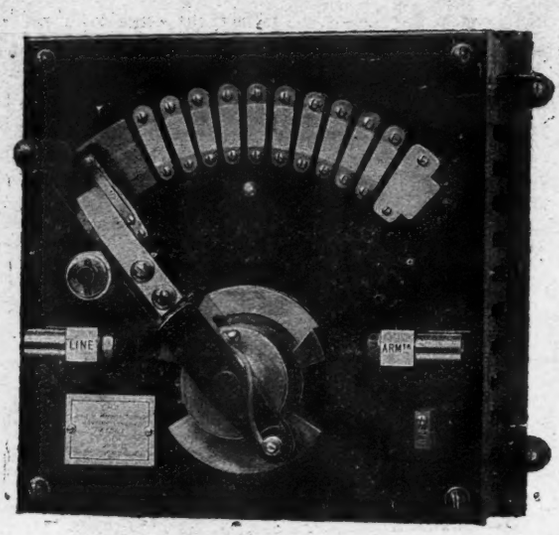


Fig. 3.—Starting Switch for Large Currents.

are able to turn out a high-grade apparatus at moderate prices. We understand that the department of the works in which these switches are manufactured, is in charge of Mr. Walter F. Jones, late of the Electrical Transmission Company, of Hammersmith.

Peace Illuminations.—A considerable amount of rapid illumination work was placed in the hands of the Electric Lighting Boards Company on Monday, and this was a most suitable occasion to show how rapidly electricity can be applied on this system as compared with the installation of gas devices. Many of the orders for illuminations did not reach the company until 4 p.m., but the illuminations were fully alight by 8 o'clock. Amongst the installations was a large display at the P. and O. offices in Northumberland Avenue, and at the United Service Club in Pall Mall, opposite the company's own offices, where there was also a large display. A number of the Royal warrant-holders similarly had displays in Regent Street and Bond Street; among the restaurants illuminated was the Café Royal. A record fixing in the evening was that of 280 8-c.p. lights in 1 hr. 20 min., by two men and one boy, including six principal connections, which, taking into consideration the difficulty of working in view of a large and demonstrative crowd, comes very close to the company's French and American time records for rapid illuminations on the E.L.B. system.

Railway Safety Appliances.—A very handsome volume has been issued by Messrs. Saxby & Farmer, Limited, containing 70 excellent illustrations, with brief descriptions, of installations carried out by them on the interlocking and block systems with which their name is inseparably associated. Examples are given from all quarters of the globe, and we note that in some cases hydraulic power has been employed for operating the signals and points. The system is not confined to railway working; the installation supplied by Messrs. Saxby & Farmer for the Tower Bridge is illustrated, as well as the signal cabin at the Old Haymarket junction of the Liverpool tramways for working the interlocking points and signals in use there. The Dover electric tramways also employ Messrs. Saxby & Farmer's system.

Westinghouse Electro-Pneumatic System.—A well-got-up pamphlet has been issued by the Westinghouse Brake Company, Limited, illustrating and describing their electro-pneumatic system of signalling on railways, of which a description has been published in our columns. Since 1891 19 railways in America have adopted this system, and three British railway companies have put down experimental installations to the extent of over 200 levers. The points, signals, gates, &c., are worked by compressed air motors, controlled by electrical means, and the hand-levers are mechanically interlocked, while the movements of the points, &c., are electrically indicated in the locking-frame; if for any reason the proper movement does not take place, the levers are locked until the obstruction is removed. The 47-lever installation at Bishopsgate station is illustrated, with many of the details, as well as other plants in England and abroad. The automatic block system of signalling installed on the Boston Elevated Electric Railway is explained, as well as a system of semaphore signals operated entirely by electricity. The company has issued a statement in refutation of allegations to the effect that the electro-pneumatic system failed through frost and snow last winter in certain American towns; the statement embodies reports from the railway officials, which go to show that the difficulty was due to frozen snow between points, &c., which would have happened with any system whatever.

"Science Abstracts."—We are informed by the editor, Mr. G. W. de Tunzelmann, that large additions have been made this year to the list of periodicals dealt with, making a total of 150; the value of this periodical, therefore, already so useful to engineers, is proportionately increased. An immense amount of time can be saved, when looking up special subjects, by a reference to *Science Abstracts*, but, curiously enough, many engineers, who, by virtue of their membership of the Institution of Electrical Engineers, are necessarily in possession of the abstracts, forget to consult them; we know that this is so, because inquiries on technical matters are constantly coming to our hands which are not of sufficiently general interest for insertion in our "Correspondence" columns, and in answering these privately, we have frequently found all that could be desired in the pages of *Science Abstracts*.

Trade Announcements. — The Horsfall Destructor Company, Limited, announce that from June 1st their head office has been removed to their new works—Lord Street Works, Whitehall Road, Leeds. It is anticipated that great benefit will accrue from the head office and works being under one roof, instead of their being, as hitherto, in different parts of the town. The offices and works have been laid out specially for the company's requirements, and in such a manner as to enable them to deal with large contracts with the greatest facility and dispatch.

Mr. August Reichwald informs us that he will remove on 9th inst. to larger premises at Finsbury Pavement House, Finsbury Pavement, E.C.

The Union Electric Company, Limited, of 151, Queen Victoria Street, have appointed Mr. James Gray, of 19, Waterloo Street, Glasgow, as agent for the sale of their arc lamps for all industrial purposes. Mr. Gray is to arrange a showroom to exhibit the latest types of both open and enclosed, direct and alternating current, flame and triplex lamps, so that prospective purchasers in Scotland will have the opportunity of seeing them at work there.

We are informed by Messrs. Veritys, Limited, that they have taken temporary premises at the Edinburgh Chambers, Baldwin Street, Bristol, hitherto occupied by Mr. A. H. Dowson, as agent for the Sun Electrical Company, Limited, and Messrs. Johnson and Phillips, who has now relinquished such agencies, having accepted a position with Messrs. Veritys, Limited, as their manager and representative in Bristol and the western counties. More suitable premises are being arranged for, and the company will then carry large stocks of all their various specialities for the convenience and benefit of their customers in the West of England and South Wales.

The City Electrical Company, Limited, has opened offices at 5, Tottenham Street, London, S.W.

The Westinghouse Works at Manchester.—The *Practical Engineer* says that so far as building operations are concerned, the new works of the British Westinghouse Company, at Trafford Park, Manchester, are now complete, and under the direction of Mr. W. C. Mitchell, the superintendent, rapid progress is being made in the equipment of the various shops, about 1,500 men being now employed in installing and assembling the machinery and manufacturing plant. All the cranes, which are being entirely supplied by English makers, have now been delivered and placed in position on the tracks, and quite 60 per cent. of the general machinery has been delivered or installed, but as this represents only 25 per cent. of the total value, it will be seen that the principal heavy plant, including a number of exceptionally powerful lathes, planers, &c., is yet to be delivered. The tool room, and some sections on the upper floors, are now in running order, whilst several sections on the ground floor are working on details for the equipment of the works, but not in manufacturing. Hydraulic lifts for the various shops, supplied by Messrs. Musker, of Liverpool, are also in operation. The electrical power now being used is developed by two temporary locomotive boilers through a 250-kw. generating set. A large battery of Babcock & Wilcox boilers, each of 480 h.p., will, it is expected, be ready in about a week or so, and a pair of 1,200-h.p. Westinghouse vertical Corliss engines are now being assembled on the foundations. The part of the plant which is, perhaps, in the best running order is the pattern-making and carpenters' shops, which are equipped with the most modern and improved wood-working machinery. The steel foundry, with its system of 20-ton open-hearth Wellman tilting furnaces, is well advanced. The iron foundry has been somewhat delayed, owing to the failure of contractors to deliver the equipment on time. Large 60-in. and 72-in. cupolas are, however, now in process of erection, and core ovens, tumbling barrels, and other equipment are also being pushed forward, so that it is anticipated that in a week or two moulding will be commenced in this department.

Wolverhampton Exhibition.—Messrs. C. Wüst & Co., of Seebach, Zürich, Switzerland, who have an exhibit at Wolverhampton, have sent us some of their circulars. Their exhibit includes many specimens of electric-driving applications, using their new multi-speed reversing alternating motors; also noiseless helicoidal high-speed gear, and new frictionless tachometers (Aumund's system). The driving exhibit includes a Swiss chalet, opposite the Machinery Hall, where lathes, drilling machines, saws, &c., are electrically driven with three-phase currents.

Germany.—A notably large crane has lately been completed at the shipbuilding yard of the Howaldt Shipbuilding Company, at Kiel, Germany. The crane, which is electrically operated, weighs 450 tons, and is able to lift a load of 150 tons; it is located on a strip of land between two docks, so that it can deal with loads on either.

CARDIFF CORPORATION TRAMWAYS.

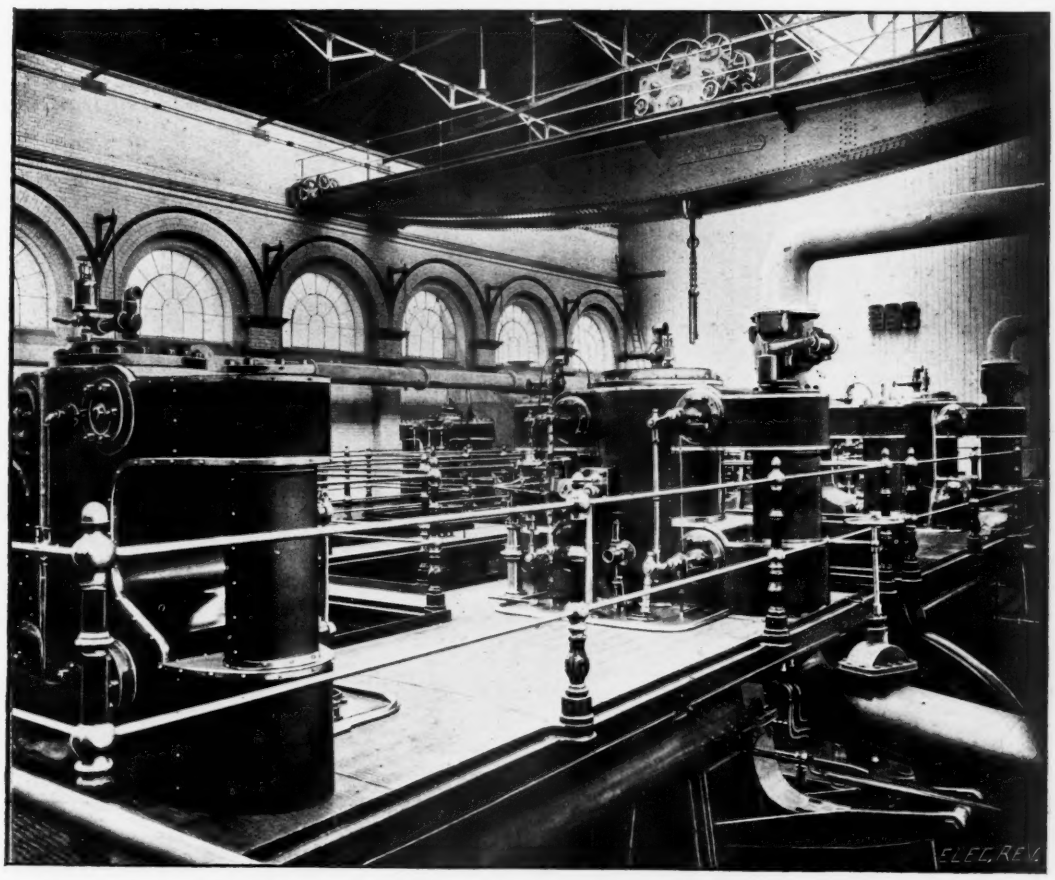
The county borough of Cardiff, the metropolis of the principality of Wales, has a population of 164,315, and a rateable value considerably over a million sterling. That it is a growing town is shown by the fact that, during the last 20 years, the population has just doubled, whilst the rateable value has increased in a still higher ratio.

The Corporation in 1898 promoted a Bill in Parliament seeking powers to borrow money for various important improvements, including the construction of tramways and the purchase of land for buildings in connection therewith; this Bill in due course received the Royal Assent. The amount of money sanctioned for tramway purposes was £160,000 for permanent way construction, and £30,000 for the purchase of lands for the power station and the car depôts. The period for repayment was fixed by the Act at 60 years for lands and 30 years for the buildings. All other monies to be borrowed for tramway purposes, such as plant and equipment, cars, &c., were to be such as might be sanctioned by the Board of Trade. During this important period Mr. W. Harpur, M.I.C.E., the borough engineer of Cardiff, acted as engineer to the scheme.

During 1899 a chairman and deputy-chairman of the Tramways Committee, and the borough engineer, acting on instructions from the Council, visited all the important tramway systems in the kingdom, and presented a lengthy and detailed report thereon, with the result that the Council finally decided to adopt the overhead system of electrical traction in preference to any other, although at one time the conduit system was suggested—in fact, the estimates placed before Parliament in the Corporation Bill were based on the latter.

Four sites were purchased for the power station and car depôts, at a total cost of £24,354.

In June, 1900, Mr. Arthur Eliis was appointed electrical engineer to the tramways department, and took up his duties in September of the same year. In the month of December following he was appointed borough electrical engineer and manager of the electric lighting and tramways undertakings of the Corporation. Immediately after taking up his duties in connection with the tramways, he prepared details of his requirements in connection with the power station, in order that the work might be proceeded with without delay, the power station being the most important matter to be dealt with.



View of Cylinders and Valve-Gear of Musgrave Engines.

Upon receiving these details of requirements, Mr. Harpur, the borough engineer, who has acted as architect for all buildings in connection with the undertaking, immediately proceeded to prepare the plans of the buildings. As soon as these were ready, the borough engineer, with his own men, put in the concrete foundations, the structural details of the buildings in the meantime being prepared and tenders got in. By this means at least three months were saved. The work of putting in the foundations was commenced in December, 1900; on account of the peculiar nature of the subsoil, excavations had to be made to an average depth of 17 ft.

The power station buildings are all that could be desired, and the borough engineer is to be complimented upon their substantial nature. The buildings are chiefly of red brick, with stone copings, &c. A spacious entrance hall is provided, on the right and left of which are the battery room, stores room, mess room, repairs shop, and smiths' shop, workmen's lavatories, &c. Immediately over these rooms are the offices of the station staff, comprising in all five large rooms, complete with lavatories, &c. A bathroom is also provided for members of the staff. The staff offices are reached by means of a staircase leading from the main entrance hall, as well as from the switchboard gallery.

The engine room and boiler house are situated immediately behind the offices. The former is a very fine room, provided with excellent ventilation. It is 104 ft. long, 60 ft. wide, and 56 ft. high, and is lined throughout with cream-coloured glazed brick. At intervals along the side walls substantial piers with semi-circular arches are provided, upon which the rails for the crane are fixed.

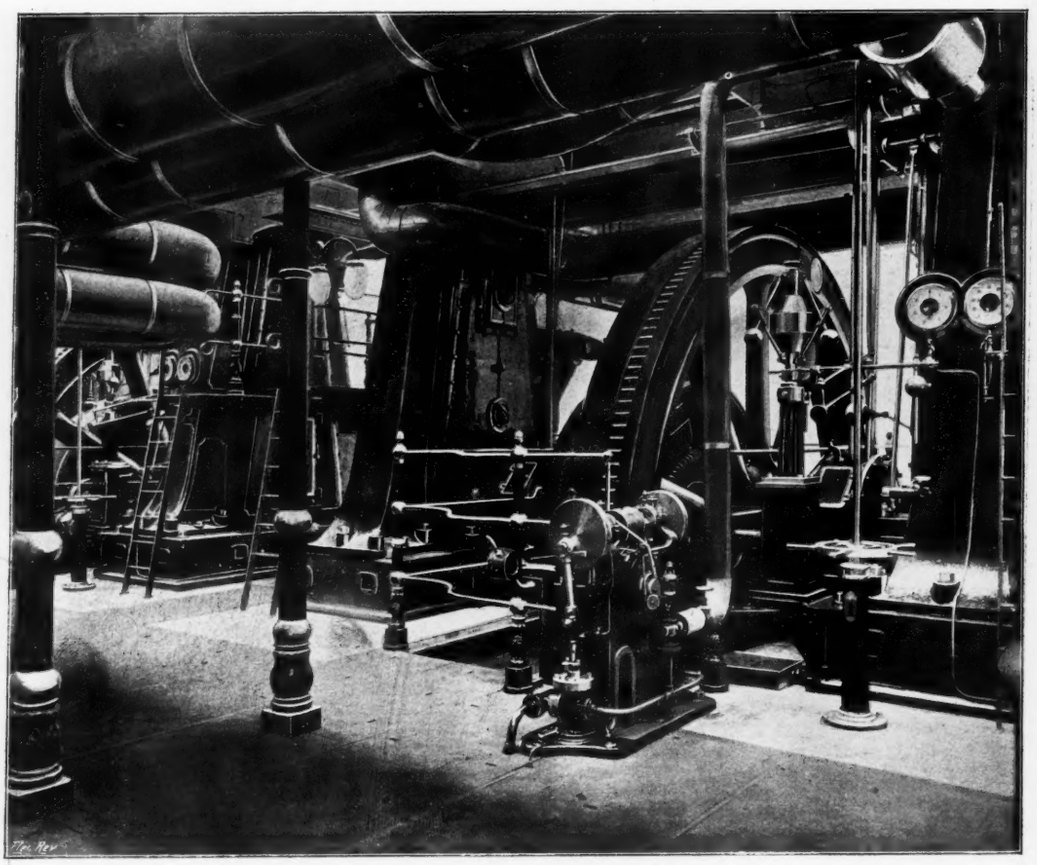
On one side of the engine room is the boiler house, of the same length as the engine room, 46 ft. wide and 48 ft. high. The walls of the boiler house fronting the boilers are lined with cream-coloured glazed bricks, which give a very clean appearance. The front portions of the boiler seatings are also lined with glazed bricks. Immediately to the side of, and adjoining the boiler house, is provided a building running the full length of the boiler house, into which the coal trucks are brought direct from the railway siding coupled up to the Taff Vale Railway Company's system. From this building the coal can be tipped either into the bunkers above the boilers, or into the coal storage below the level of the siding. At one end of the boiler house a large pump room is provided, with space for 12 feed pumps of the Weir type.

The roofs throughout are supported by mild steel principals and framing of neat design, composed of angles and flat tie-bars.

The buildings have been erected by Messrs. W. Symonds and Co., at a contract price of £16,100; the whole of the steelwork was provided by Messrs. A. D. Dawnay & Sons, Limited, of Cardiff, as sub-contractors.

The chimney stack is situated at the front end of the building, and is 160 ft. high; it is built of red brick, octagonal in shape. It is surmounted by a very heavy granite capping, made up of eight stones, each weighing 30 cwt. The hoisting and fixing of these heavy stones was a matter of great difficulty. The stack was erected by Messrs. Clark & Co., of Cardiff, at a cost of £1,563.

In getting out the arrangement of the buildings, Mr. Ellis fixed their position in such a way as to leave room on the other side of the engine room for an exact duplicate of the boiler house and coal bunkers, so that when it is completed, the engine room will be between two boiler houses. These extensions, he anticipates, will be required at an early date.



Musgrave Engines and Westinghouse Dynamos.

The present buildings are all finished off with temporary brick ends. There is sufficient room on the present site to extend the buildings a further 300 ft., with two chimney stacks at each end.

At one end of the buildings and in front of the offices, a large cooling pond is being provided for condensing purposes. The water in the pond is drawn from a fresh water brook, running along one side of the main building, and dividing the power station site from that of the main car depôt. Mr. Ellis intends when necessary to erect cooling towers over the pond, which has been built with this end in view, of very substantial construction, by the public works department, under the directions and supervision of the borough engineer, who prepared the detailed drawings to meet the requirements supplied to him by Mr. Ellis.

The tramways department is very fortunate in having the power station on a site provided with a supply of water and a railway siding, and it is hoped that with these advantages the cost of generation will work out at a very low figure.

The present power station buildings will be fully occupied

with plant during the current year. At the present time there are in the engine room four engines, each of 500 H.P., and there are two more on order of 1,600 H.P. each. The engines have been and are being supplied by Messrs. John Musgrave & Sons, Limited, of Bolton, Lancashire. They are all of the vertical cross-compound condensing type, of heavy design. They work under a steam pressure of 140 lbs. per sq. in., and run at a speed of 100 revolutions per minute.

Each engine is fitted with its own condenser, driven by side levers from the crossheads. The air-pumps of the smaller sets are 25 in. in diameter, 12 in. stroke, with steel air-pump, bucket rod, and deep buckets having a series of small valves, and delivery grid with valves.

The condensers are of the injector type, with suitable water regulators. On the large sets are two air pumps, each of 30 in. diameter. The condensers are placed below the engine room floor level, and immediately at the rear of each engine. Each engine is provided with steam-driven barring gear.

The engines are capable of withstanding an overload of 25 per cent. for two hours, and 50 per cent. for short periods. They are fitted with Corliss valve gear on both cylinders, worked by means of eccentrics fixed to the crankshafts. Each engine is provided with an automatic cut-off motion connected direct to the governor. The engines are entirely enclosed, and forced lubrication is used for all parts, the oil pumps being worked by eccentrics.

The governors on the engines are of the quick-speed type, driven by ropes from the crankshafts. Means are also provided so that the speed can be altered up or down by hand whilst the engines are running, the governing variation from no load to full load being 2½ per cent.

The cylinders are of hard sound metal; the H.P. cylinder is 17½ in. in diameter, and the L.P. cylinder 35 in. diameter, both having a stroke of 3 ft. The piston rods are fitted with United States metallic packing. The rods are of 4 in. diameter steel. The crankshafts are made of hollow Siemens-Martin steel, 12½ in. diameter, and 15 in. at the wheel boss. The fly-wheels are 16 ft. diameter, made in halves, having a weight of 14 tons in the rims alone, the total weight of each wheel being 35 tons.

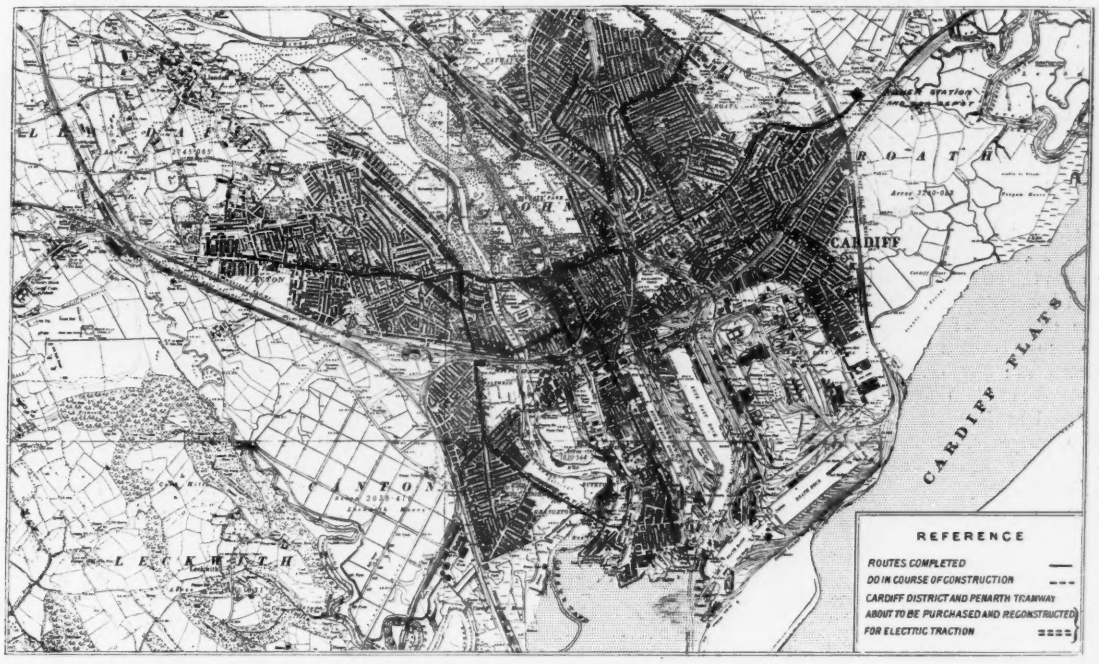
The larger engines have cylinders of 38 in. and 58 in. diameter respectively, with a stroke of 3 ft. 6 in. The piston rods are 6 in. and 6¼ in. in diameter. The crankshafts are 18 in. diameter, and 23 in. at the wheel boss. The fly-wheels are 19 ft. diameter, built up in sections, with a weight of 38 tons in the rims, and a total weight of 75 tons each.

Each engine is fitted with a neat and substantial packing stage, with ornamental hand rails and pillars, for getting at cylinders, valve gear, &c., and all these are coupled together so that the attendants can get from one engine to any other with ease.

The four 500-H.P. engines cost £14,508, including spare parts and foundation plates, and the two 1,600-H.P. engines on order £14,742 17s.

The four generators at present installed were supplied by the British Westinghouse Electric Manufacturing Company, Limited. They have an output of 300 KW. each, and are capable of withstanding overloads of 25 per cent. for two hours, and 50 per cent. for short periods, without sparking and without moving the brushes. The generators are of the multipolar type, with armatures mounted directly on the shafts between the high and low pressure engines. The armatures were forced on to the shafts under a pressure of 70 tons.

The generators work as compound machines on tramway loads at a pressure of 500—550 volts, and as shunt machines on lighting loads at a pressure of 460—500 volts. The four generators cost £7,390.



Map of Cardiff Tramways.

The two large generators on order are being supplied by Messrs. Dick, Kerr & Co., Limited, of London. They have a capacity of 900 KW. each; they are being made to meet the same conditions as those already installed, and will be mounted on the shafts of the engines in a similar manner. These two generators are being supplied at a cost of £5,560.

There is also in the engine room an 80-KW. motor-generator, which works in conjunction with a battery of accumulators, and serves several purposes, amongst which are the following:—

It receives current from the main tramway bus bars at 500 volts, and gives out current at a pressure of 100—140 volts for charging the battery or supplying the works' lighting independently (which can also be supplied direct from the battery when the motor-generator is not working).

It can work in the reverse order and receive current direct from the battery at 100 volts, and give current at a pressure of 500—550 volts. By this means it is possible to shunt cars, &c., in the depôts when the main plant is shut down, and to work the various motors in the power station in connection with the mechanical stokers, &c., when raising steam on the boilers previous to starting up the plant.

It is also used for running any specially early cars or repair trolleys for night work on the overhead equipment.

The motor-generator was supplied by Messrs. Bruce

Peebles & Co., of Edinburgh. It consists of two generators coupled together, with a fly-wheel between the machines. The generators are mounted direct on a common bedplate.

The low-pressure machine has a double-wound armature, with a commutator at each end. The reason for this is to get the maximum output of the machine and to run the set at a constant speed.

To enable the low-pressure side to generate an output of 600 amperes at 140 volts, or 84 KW., the high-pressure side requires an input of 100 KW., at 500 volts, running at 500 revolutions per minute.

With double-wound armature and a pressure of 100 volts supplied to the low-pressure side, the two armatures being in parallel, the set is driven from the battery at a speed of 600 revolutions per minute, and the high-pressure side generates its full output of 170 amperes at 500 volts, or 84 KW.

The motor-generator can by this arrangement always be worked at its highest efficiency without any weakening of the fields, except the small amount necessary to reduce the voltage on the low-pressure side as a dynamo from 140 to 100 volts.

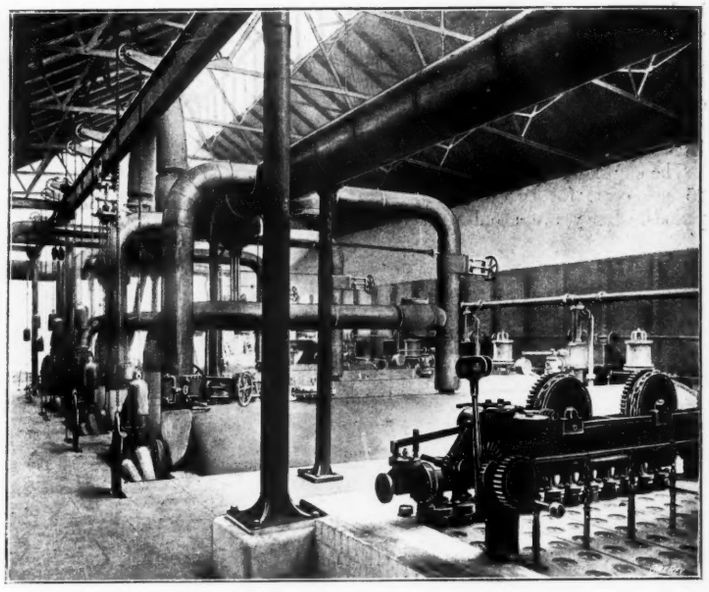
The generators are six-pole machines, the field coils being wound on separate formers for easy removal. The armatures are of the drum type. The bearings are of the swivel self-oiling type. The fly-wheel of the motor-generator weighs 1 ton. The battery of accumulators was supplied by the Tudor Accumulator Company, and consists of 56 cells with 31 plates in each. The cells themselves consist of lead-lined wooden boxes supported on oil insulators.

The capacity of the battery is:—2,100 ampere-hours when discharged at 210 amperes: 1,800 ampere-hours when discharged at 360 amperes; 1,620 ampere-hours when discharged at 540 amperes. The normal rate of charge is 300 amperes, and the maximum rate of charge 375 amperes. The duties of the battery, as previously mentioned, are the direct lighting of the power station and car depôt and the supply of current to the motor-generator. The battery is placed in a room at one end of the engine room.

Exterior of Power Station.

In the engine room there is a 20-ton hand-driven travelling crane, which can operate the whole length of the building. It is intended eventually to equip the crane electrically, and thus save time and labour. The crane was supplied by Messrs. Joseph Booth & Bros., of Leeds. It has a span of 60 ft. and a lift of 35 ft.

Down the centre of the engine room, between the two rows of engines and generators, there is a gangway supported by means of ornamental columns at a height of 12 ft. above the engine room floor level; the gangway is coupled up to the stagings around the various engines, and also leads on to the switchboard gallery at one end of the engine room. It is approached at the switchboard end by means of a double staircase from the engine room floor level, and by a staircase at one side of the gangway at the opposite end of the engine room. The whole of the upper gangway is protected by means of ornamental columns and handrails of similar design to those on the stagings of the engines.



Main Steam Range in Boiler House.

This central gangway serves two purposes: the easy access to the cylinders and valve gear, and the supporting of the main steam pipes running down the centre of the room, the pipes being supported by carriers on the underside of the gangway.

The main switchboard is built direct into the main wall at one end of the engine room, and stands back in a recess, taking up 42 ft. of the total width of the room. Immediately in front of the board there is a clear space 10 ft. in width. The gallery is carried right through into the boiler house and to the coal bunkers beyond, so that the engineers in charge can control the whole station with the smallest amount of trouble.

(To be continued.)

Carbide Patents.—The anomalous position as to patent rights covering the manufacture of calcium carbide in Europe, and the Continental makers' combination, have brought about a curious state of things. At the present time American, Swedish, German, and French carbides are all to be found simultaneously passing through the Port of Hamburg; because for some reason or other the manufacturers of each country seem to consider it their duty to export their products to one another's territory. If American carbide is being sent to Germany, attempts are to be made to send German carbide to America (the patent monopoly in the latter being presumed capable of demolition), which appears to indicate a position of affairs somewhat resembling the phenomena of that land where all the boys were girls and all the girls boys. Carbide is also being sent by the French Compagnie Générale de l'Electro-Chimie to the Santa Fé Railway of the Argentine Republic, but that carbide is transferred to shipboard at Trieste and Antwerp; this peculiarity being due, we imagine, to the extremely irregular rates charged by different French railway companies for the carriage of the material over their lines.

ELECTRIC LIGHT AND POWER NOTES.

Alsace-Lorraine.—M. René Koechlin, engineer, who has already executed several hydro-electric installations in Switzerland, has just completed, with the assistance of M. Potterat, an engineer of Berne, a scheme for the construction of a hydraulic power station on the Rhine for the development of electrical energy. An application for a concession has been made to the Government. The power to be obtained by the proposed works will be 23,000 H.P., and will be employed for motive purposes. A sum of 15,000,000 marks will be required to carry out this important undertaking. If this project is realised, Mulhouse will possess perhaps the most important hydro-electric power station in Europe.

Barking.—The annual report of the electric light undertaking shows that the deficit amounts to £273, as against £1,005 last year.

Birkdale.—It is now definitely stated that electricity will be supplied throughout the whole of the district by the Birkdale District Electric Supply Company. The charge is to be 7d. and 2d. per unit, according to the maximum demand system.

Blackburn.—Owing to the loss of over £7,000 on the year's working of the gas undertaking, the Blackburn Gas Committee has decided to increase the price of gas. The loss on the tramways for the past year was about £6,000, and on electricity about £1,000. How is this for "relief of the rates?"

Blackpool.—The annual report of the Electricity Department to March 31st shows a total output of 2,262,516 units, as against 1,760,459 for the previous year, of which 924,415 were for private supply, 289,659 for public lighting, 804,058 for traction, and the rest used in the works or lost. The total income was £27,911, and the expenditure £18,720, leaving a gross profit of £9,191. After payment of interest and sinking fund, there remained only £57 11s. 10d. During the year the capital expenditure was increased from £142,749 to £168,688. Generating costs amounted to £14,053.

Bridlington.—On the 28th ult. the T.C. resolved to engage Mr. F. H. Medhurst as consulting engineer in connection with its electric lighting scheme.

Bristol.—The City Council has discussed a report from the Electrical Committee stating that in consequence of the rapid growth of the undertaking preparations for the enlargement of the Avonbank works should be made at once. Alderman Pearson pointed out the extreme risk that they had run in dealing with their Christmas load, the whole of their power being in use and no reserve available in case of a breakdown. The present extension was estimated to cost as follows:—Foundations, £9,564; superstructure, £13,000; boiler house and plant, £12,900; engine room plant, £19,200; piping work, £3,500; motor and auxiliary plant, £775; lighting, £420; contingencies, 2½ per cent. The total was £61,000. The Committee asked the Council to authorise the work being done by the Committee's own officers under Mr. Faraday Proctor, not calling in an outside architect, but with power of reference to Sir Benjamin Baker. The report was stoutly challenged by several members who are generally in opposition to the Electrical Committee's schemes, but by an overwhelming majority the Council gave the sanction Alderman Pearson asked for. It also authorised the purchase of extra water-softening plant for the Temple Back station at a cost of £2,915.

Caversham.—The U.D.C. on May 27th discussed a proposal to apply for a prov. order for electricity supply. On a division the voting was equal, and the chairman declined to give a casting vote.

Cleckheaton.—The Electricity Committee of the D.C. has decided to fix the price of electrical energy for lighting purposes at 5d. per unit, and for motive power at 2d. per unit.

Dungannon (Tyrone).—The U.C. has under consideration a scheme submitted by Mr. E. G. Cruise, of London, for the electric lighting of the town.

Epsom.—Mr. Hawtayne, consulting engineer to the U.D.C., having reported that the engines supplied to the electric lighting works materially exceeded the guaranteed steam consumption according to the specification, the Council has decided that the firm who supplied the engines shall be asked to substitute two more efficient engines.

Faversham.—Upon the recommendation of the engineer, Mr. H. Talbot, it has been resolved to borrow £24,100 for electric lighting purposes.

Hamilton.—An agreement between Messrs. Edmundson and the Corporation has been signed, and the T.C. has decided to dispose of some ground at Almada Hill for electric lighting works. The engineer's report states that the total cost of the works has been reduced to £31,494.

Kingston-on-Thames.—The annual report of Mr. J. E. Edgcome, the borough electrical engineer, states that new buildings and plant have been installed, and that the new mechanical stokers and Pimbley economisers are giving satisfactory results. Various extensions of cables have taken place. Financially, there is an adverse balance-sheet for the second year in succession. The total capital expenditure has increased from £59,954 to £72,047. The total expenditure for generation, distribution, &c., including capital charges, has risen from £9,283 to £9,673, the receipts also rising from £6,562 to £7,378 during the year, making a net loss of £2,294, as compared with £2,721 for 1901. The total works cost per unit decreased from 4·353d. to 3·499d., the lowest yet reached; but added to this was 2·658d. per unit for interest and repayments. The number of consumers is now 458 (an increase of 82), and the total lamps connected equal 22,885 8-C.P., an increase of 3,986. On Tuesday last the Council decided to obtain expert advice on the working of the department, at a cost not exceeding £100.

London.—Stepney.—An inaccuracy occurred in our note last week, on the result of the arbitration between the County of London and Brush Provincial Electric Lighting Company and the Stepney Borough Council. The detailed award of the arbitrator was as follows:—(*a*) That the cost of preparing, obtaining, and passing the County of London (East) Electric Lighting Order, 1897, be £710 6s. 7d. (*b*) That the costs properly incurred by the company, with the object of supply to the East End districts, be £5,814 13s. 11d. (*c*) That the costs of the award be £368 4s. 10d. (*d*) That the Borough Council pay one-half the company's costs of the arbitration; the Council to bear its own costs.

Londonderry.—The Derry C.C. has decided, after two years' consideration of the matter, to go on with the private electric lighting of the city. The scheme adopted is the one prepared by Sir W. Preece.

Mexborough.—On 29th ult. the U.D.C. electricity works was officially inaugurated.

Newport (Mon.).—The Electricity Committee has presented a return of the financial result for the year ended March 31st, which shows the following:—Gross profit on year's work, £6,431; interest on loans, £3,181; sinking fund, £2,391, leaving net profit £859. The result of the previous year's working was a deficit of £2,765, caused by the excess of interest and sinking fund over the gross profits, which only amounted to £2,557. The year just concluded is the seventh of the Council's undertaking.

Newhaven and Seaford.—The electric lighting orders granted in 1900 for Newhaven and Seaford have been revoked as from May 22nd.

Nottingham.—The City Council on Monday adopted a report of the Electricity Committee, as to the raising of £35,000 additional capital for a generating station in the Eastcroft and for the extension of the mains. In 1892 the Council authorised an expenditure of £200,000 for machinery for supplying electricity for lighting and power, and in 1902 there were 1,806 consumers. The number of units sold during the year ended March, 1902, was 4,094,897. Last year showed an increase of 77 per cent. on the output of the previous year. The number of motors connected was 288, of 955 H.P. There are 35 miles of cables in the streets. The stations in Talbot Street and St. Ann's Well Road have 11,725 H.P. available. Last year the energy supplied to the Tramway Committee was over 1,200,000 units, and it is estimated to increase by at least a million this year; it is anticipated that the works will have to supply at least 7,000,000 units during the present year. By the time the work is finished, the Corporation will have invested a sum of something like £1,400,000.

Ormskirk.—The U.D.C. is canvassing the town to find the probable demand for a supply of electricity. The cost of the proposed plant is put at £15,000. Inquiries were made as to a supply from Southport, but the terms were not considered acceptable, the latter offering to supply at 6d. per unit.

South Shields.—Mr. J. H. Cawthra, the borough electrical engineer, has issued his report for the year ending March 31st, 1902. The capital expenditure up to that date has been £138,801, an increase of £10,312. The lamps connected number 41,680, an increase of 6,655, or 19 per cent., while the consumers have increased from 680 to 778, an increase of 14 per cent. The number of units sold was 985,646, an increase of 229,820, or 30 per cent. The total revenue was £13,664, against £12,196 in the previous year, an increase £1,468. This left a gross profit of £7,750 against £6,261. The amount required for interest and sinking fund was £7,155, so that a net surplus was left of £594, as against £1,468 for the previous year, the discrepancy being accounted for by the sinking funds having been readjusted. From the net profit there was to be made a further deduction of £163 loss in respect to the working of Holborn Quay. The average price per unit to the private consumer was 3·9d. The actual cost of producing the energy was 1·29d. per unit.

Southport.—The demand during the past year has grown at a normal rate, about 8,587 new lamps having been connected, while the output returns mark the largest increase yet recorded in a year since the commencement. The consumers now number 1,021; the lamps, 65,367. The units sold were 1,462,407. The maximum load in KW. and load factor per cent. have respectively risen to 1,174 and 14·22. The units used are made up of—public and private lighting, 925,483; traction supply, 536,924. The total costs are brought down to 1·23d. per unit. The gross profit on the year's working was £10,704; less interest on loans, £4,317; amount provided for sinking fund, £4,705; surplus for the year, £1,682.

Sunderland.—The Corporation is considering the advisability of doubling the present output of electrical energy, so as to supply the various shipyards, engineering works, docks, &c. The net profit of the department last year was £1,938, and on the tramways a profit of about £10,000.

Spain.—A concession has been granted to put down a plant to utilise the water-power of the River Dilar, at Dilar (province of Granada), in the generation of electrical energy for the lighting of a number of small towns in the district.

A company has just been formed in Madrid with a capital of £240,000 to be known as El Gran Central de Electricidad de la Castellana. The company will put down a plant to utilise the water power of the River Jarama, at a point about 12 miles from Madrid, in the generation of electrical energy for lighting and power purposes. It is said that 5,000 H.P. will be available.

Swansea.—The Corporation has offered to supply electric power to the Hafod Isha Works upon the following terms:—A minimum of 150,000 units per annum at 1½d. per unit, or a minimum of 200,000 units per annum at 1¼d. per unit; the company to agree to take a supply for at least three years.

ELECTRIC TRACTION NOTES.

Belfast.—The City Council has been in communication with the Belfast Tramway Company *re* purchasing the line, but the particulars have not yet been made public.

Belgium.—The Economic Railway Company has obtained permission to substitute electricity for the horse traction at present in use. A mixed system will be used, but the underground system will preponderate. Hitherto the authorities have religiously refused any concession for running electric trams in Brussels proper, and it is worthy of note that three of the company's lines will pass through some of the busiest sections of the Belgian capital. A new and powerful central power station is to be installed without delay, for the supply of current to the proposed new system.

Birkenhead.—The Tidswell life-guard has again saved a small boy of three years, named William Bennett, who got in the way of a car in Cleveland Street. The life-guard caught up the boy and bore him safely until the car could be stopped, when he was found to be uninjured.

Blackburn.—The report of the Borough Treasurer of Blackburn, Mr. J. H. Bailey, relating to the Corporation's electric tramway undertaking, shows that the income for the year ended March 25th, was £36,488, made up as follows:—Traffic receipts, £36,168; parcels, £267; rents, £52. The expenditure, which totalled £28,439, included £7,356 for current, management £600, wages £1,084, fuel £1,455, and accident insurance and compensation for the Ewood collision £2,226. The credit balance was £8,049, but after paying interest and sinking fund, there is a loss on the year's account of £6,549, bringing the total loss on the tramways undertaking, since it was acquired by the Corporation, to £17,754.

Mr. A. S. Giles, the electrical engineer and tramways manager, in his report on the subject, points out that a complete year's working of electric traction on all routes has not yet been experienced, and that the working expenses have been swollen by the Ewood accident. He also calculates that the last few months of steam-working account for £1,257 of the year's loss. Dealing with the items of electric working, Mr. Giles says that the cost of power at 2·85d. per car-mile is a high figure, but is accounted for by the fact that the tram routes are hilly, and that the price of electric energy is 1½d. per unit. The returns for the last two months show that economy in power is being exercised, and the figures under this head are expected to be reduced next year. The cost of car maintenance will also be considerably reduced in future, and it is expected that the average cost of working during the current year will not exceed 7d. per car-mile. Mr. Giles shows that the increased fares have resulted in an advance of receipts amounting to £3,651 in a period of eight months, and draws attention to the fact that the capital charges for the year have increased by £2,939, the total being £14,740. Of this sum, £6,664 is the annual instalment of interest and sinking fund on the purchase price of the tramways. "We have very little to show now for this dead capital (the report continues), and it is a heavy weight for the undertaking to bear in the first few years of working. We are not yet paying sinking fund on all our working capital, and next year the annual charges will be higher; afterwards they should gradually reduce each year, as instalments are repaid." Mr. Giles appends the following table, showing the traffic totals for the past three years:—

	Mileage.	Passengers.	Receipts. £ s. d.	Average per mile.
1900	567,829	5,711,971	28,512 18 1	12·05
1901	687,266	6,759,511	31,329 14 5	11·79
1902	738,577	6,790,091	36,168 15 5	11·74

Cardiff.—Our local correspondent says that "the Corporation Committee at Cardiff has decided that a certificate of competency as electric car-driver shall be furnished by the tramway department in respect of each applicant approved. The rush for employment since the electric cars have come to the fore in the town has been phenomenal. There are no fewer than 3,500 applicants for positions on the tramway system already."

Chatham.—Last week the B. of T. (represented by Major Pringle, Mr. Trotter, and others) thoroughly inspected the Chatham and District Light Railway Company's lines with a view to their being opened for the public use. The overhead equipment is chiefly of the side-bracket type, with occasional span wires where necessary. The cars have been made by Messrs. Geo. F. Milnes & Co., Limited, Hadley, and seat some 50 passengers each. The lines run from Luton, through Chatham, and on to the dockyard and barracks and various other naval and military establishments, and from thence through Old Brompton to New Brompton, Gillingham, and afterwards into Luton again. In all upwards of eight miles of rails have been laid by the company. The power station has been equipped with boilers by Messrs. Yates & Thom, of Blackburn, who also supplied the three low-speed horizontal engines. The chimney shaft is of iron, 150 ft. high, and its diameter is 7 ft. There is a small engine for lighting, by Messrs. Belliss & Morcom. The generators are by the British Thomson-Houston Company, Limited. There will be 25 cars running as at present arranged.

Devonport.—In turning a sharp curve on Tuesday last, an electric tramcar left the rails, and, colliding with a lorry, overturned. There were several people in the car at the time, but with the exception of the conductor, who was badly injured and had to be removed to hospital, the passengers escaped with only a severe shaking.

Dewsbury.—It is hoped to have one or two sections of the tramways open towards the end of July or the beginning of August. For some time negotiations have been proceeding between the Corporation and the Traction Company, respecting the supply of energy for places outside the borough, and it is now reported that terms have been agreed upon.

Doncaster.—The first section of the municipal electric tramways was opened by the Mayor on Monday.

Halifax.—The introduction of a system of parcel traffic on the electric trams is recommended by the T.C. For each two stages 1d. per 7 lbs. will be charged, with 2d. up to 28 lbs., and 3d. up to 56 lbs.

Light Railways.—Last Friday's *London Gazette* contains notices of the following applications which have been made for light railway orders:—Gloucester and District, Corporation; London United Tramways (Light Railways Extensions) No. 3, lines in Middlesex, Buckingham and Berks; Maidstone, Corporation; Barking Light Railways (Extensions) U.D.C.; Southend-on-Sea and District, Council; Crystal Palace (C.P. Light Railway and Tramway Co., Ld.).

Pontypridd.—A joint meeting of the Pontypridd and Rhondda Valley District Council has been held with regard to the proposed purchase of the British Electric Traction Company's tramway between Pontypridd and Porth (the entrance to the Rhondda proper), and the advisability of a joint purchase of the undertaking at once was discussed. It was decided to ask the company to name the sum for which they would be prepared to sell.

Preston.—The Earl of Jersey on Tuesday last week presiding at an inquiry into the application of the Electrical Construction and Maintenance Company to make a line from Lytham, meeting the proposed Corporation tramways at Preston, said that he and his colleagues were of opinion that the line did not come within the purview of Clause 9, the competitive clause, and upon that ground alone they felt it would be no use their attempting to recommend an order in that case.

Whitechapel and Bow Railway.—At the formal opening of the Whitechapel and Bow Extension Railway last Saturday, Mr. Perks, M.P., referred to the advantage the new line would be to the District Railway. The question of electrical traction had not been lost sight of, and he trusted that in 18 months they would see the whole line from Hounslow to Upminster working on an electrical system.

Wrexham.—At a meeting of the T.C. last week, Mr. Chadwick announced his resignation as chairman of the Electricity Supply Committee. This was in consequence of his action in committee, in refusing to accept a resolution from Ald. Thos. Jones slightly in favour of the Wrexham and District Electric Tramways, Limited, in respect of charges to be made by the Corporation for electricity after midnight, being ruled out of order by the Mayor. The grievance was because Ald. Jones gave evidence in London in support of the Bill promoted by the tramway company, and Mr. Chadwick said it was absurd to say that Mr. Jones went to support the Bill as a private individual; it was because he was an Alderman and ex-Mayor that his evidence was sought for and given.

Maritzburg.—From some Natal newspapers which have come to our hands, we gather that last month the City Council adopted a report relating to electric tramways which calls for something more than mere mention on this side. It seems that Mr. F. W. Jameson, the borough engineer, and Mr. W. F. Skidmore Ashley, the borough electrical engineer, after lengthy comments upon general questions and the best routes for running cars so as to develop new suburbs and to relieve congestion in the city, go on to recommend a single-deck car with bogie trucks and sliding bow, and on the latter point we quote the following remarks:—

"The 'sliding bow' seems to call for special attention, as it has advantages over the 'trolley' which, in our opinion, outweigh altogether the mere assertion that a foreign make should not be encouraged because this is a British Colony, nor does it seem a sound argument to advance that, because the trolley system is adopted practically throughout the United States and Great Britain, it must necessarily be introduced into South Africa.

"We are not disposed to admit the superiority of the Anglo-Saxon over the Teuton in this matter, but consider rather that the

continued adoption of the 'trolley' has been due to the rigidity of design which is always a characteristic in the main features not only of the electric car, but of all mechanical appliances in the engineering world in their initial stages. We have endeavoured to secure for your system that which is best, irrespective of what may be thought of the policy of our action in the matter, and what appeals to us so strongly we feel sure will also be appreciated by yourselves after a careful study of the points urged in favour of the 'sliding bow,' which briefly may be summarised as follows:—(*a*) Less wear on overhead wire, especially when rounding curves; (*b*) more silence in action than the trolley; (*c*) less complication in overhead wires at curves and turn-outs; (*d*) ears and frogs of more substantial design; (*e*) no soldering of overhead wires necessary; (*f*) no trailing rope from back of trolley arm required; (*g*) no possibility of jumping off the trolley wire; (*h*) the 'bow' is reversible so that in changing direction of car the lights would not be put out; (*i*) 'sparking' possibilities greatly reduced. Finally then, viewed upon its merits, we think a single-deck, bogie-wheel car, having the 'sliding bow,' is undoubtedly most suited to your needs, and we therefore strongly urge your adoption of the same."

The following tables of expenditure are given:—

PROBABLE EXPENDITURE.

514,800 supply units of electricity	£4,290 0 0
Thirteen conductors at 9d. per hour	1,501 10 0
Thirteen motor men	2,002 0 0
Inspector	300 0 0
Linesman	240 0 0
Armature winder	240 0 0
Proportion electrician's salary	100 0 0
Maintenance of permanent way and rolling stock	1,000 0 0
Management and offices expenses	1,000 0 0
Add interest and depreciation on, say, £75,000 at 8 per cent.	6,000 0 0
	£16,673 10 0

PROBABLE REVENUE.

Receipts based on the assumption that the average number of passengers carried per car-mile will be eight, and that the fare will be 3d. per car-mile	£20,592 0 0

ESTIMATE.

Buildings	£12,000 0 0
Plant	12,000 0 0
Permanent way and feeders	22,000 0 0
Overhead construction	8,800 0 0
Car equipment	9,000 0 0
Embankment and bridge	4,000 0 0
	£67,800 0 0
10 per cent. contingencies	6,780 0 0
	£74,580 0 0

The *Natal Mercury* for May 8th takes exception to the adoption of this report, and says:—

"The idea of the engineers seems to us to be to provide Maritzburg with a system different from anything of the kind elsewhere in South Africa, and, so far as we can see, for no other sufficient reason than to be different. It may be noted also that the estimate of probable revenue is placed at double the sum put down by the Durban engineers when they reported on an electric tram system for the town, but the most notable point of all is the advocacy of the 'sliding bow' as against the 'trolley.' . . . . It is rather amusing to think that the question of the superiority of the Anglo-Saxon or the Teuton in matters connected with electric traction should fall to be decided by a couple of young engineers in Maritzburg, but they have decided the matter, and given their vote in favour of the Teuton. The adoption of the sliding bow means practically that Maritzburg intends having her tramways made in Germany, as it is in that country where the sliding bow is in use and the patents held. The arguments advanced in favour of the sliding bow, will, we hardly think, be admitted by anyone who knows what it is; but the sliding bow is no new thing, and if it had been so pronouncedly superior to the trolley, it would require very much more experienced men than Messrs. Jameson and Ashby to convince us that the best American and British engineers would not have abandoned the trolley principle for some form of the sliding bow. . . . . Of course, Maritzburg can please itself absolutely in the matter, and have a German system if it likes. The trolley system, however, gives most excellent results, as the Town Council of Maritzburg can see for themselves if they run down here. And surely, what is good enough for Durban and the rest of South Africa is good enough for Maritzburg, when to be different means that money borrowed in England is to be spent by the Corporation in Germany."

TELEGRAPH AND TELEPHONE NOTES.

French Telephones.—The Central News Paris correspondent says that the Minister of Commerce has signed a convention drawn up by the British Post Office extending the telephone service between England and France.

Telegrams to the Cape.—The Eastern Telegraph Company, Limited, notified some days ago that, owing to a very severe storm in the neighbourhood of Cape Town, all the Government landlines in that district were disorganised. From the same cause a ship was driven ashore and interrupted one of the West Coast cables and damaged the other. In consequence the delay of telegrams to Cape Colony must occur. The East Coast cable and the landlines from Durban to the Transvaal were working well and there was no delay to either Johannesburg or Pretoria.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus	June 20, 1899	..
Puerto Plata-Martinique	May 6, 1902	May 27
Puerto Plata-Martinique	May 30, 1902	..
Moulmein-Bangkok	May 7, 1902	May 7
Moulmein-Bangkok	May 16, 1902	May 21
Trinidad-Demerara No. 1	Aug. 27, 1901	..
St. Lucia-Martinique	May 7, 1902	..
St. Lucia-St. Vincent	May 7, 1902	..
St. Lucia-Grenada	May 7, 1902	..
Dominica-Martinique	May 5, 1902	..
Guadeloupe-Martinique	May 5, 1902	..
Hong Kong-Manila	June 3, 1902	..
LANDLINES:—		
All Siberian lines between Innokentiewsk-Radde	May 29, 1902	May 30
Route *via* Hapekin on Persian territory	Feb. 24, 1900	..
Communication with Tientsin and Taku *via* Helampo	June 18, 1900	..
Moulmein-Bangkok	May 15, 1902	June 2

Telephone Exchanges.—A Parliamentary paper has just been issued giving the names of all telephone exchanges of the Post Office in the United Kingdom, with the date of opening, the number of subscribers on each exchange on December 31st, 1899, 1900, 1901, and the tariff.

Turkey.—The *Levant Herald* states that the Postal Reform Commission has proposed to the Government a very considerable reduction in the present scale of rates. The new scale will come into force on June 14th next.

Wireless Telegraphy.—A gunboat has arrived at Alderney from Portsmouth to establish wireless telegraphy between the island and the south coast of England for military and naval purposes.

The French Wireless Telegraph and Telephone Company, sole proprietors of the Branly radio-conductor, have just made an offer to instal their system in the proposed new wireless telegraph station of the Belgian Government, as well as on one of the packet boats of the State with a view of permitting the administration to compare the relative merits of the Branly and Marconi systems.

THE INQUIRY INTO THE MANAGEMENT OF THE SALFORD ELECTRICITY UNDERTAKING.

FOR some time past there have been numerous statements of a very disturbing nature in circulation regarding certain alleged charges of mismanagement and undue influence in connection with the Salford municipal electricity works. Our readers will be glad to hear that this unhappy state of affairs is now in a fair way for being brought to a conclusion, for Judge Parry opened a searching inquiry on Tuesday. We are indebted to the *Manchester Courier* for the following report of the first day's proceedings:—

As a sequel to the charges that have been made in Salford at several meetings against the members of the Electricity Committee, the Council consented to a public inquiry being held to thoroughly sift the allegations, and his Honour Judge Parry consented to sit and hold the inquiry. It was consequently opened before his Honour in the Salford Town Hall, when there was a large attendance of the legal fraternity, representing parties interested, directly and indirectly, in the undertakings of the Corporation. Those present included Messrs. W. Hunt, C. R. Turner, and Councillor F. W. Wheatcroft, who made various charges against the Council, the Committee, and several individuals connected with the works. Mr. C. H. M. Wharton represented Alderman Shaw, chairman of the Committee, against whom charges were made; Mr. Desquesne appeared for Sir Richard Mottram; Mr. Dean for ex-Councillor Howarth; Mr. Galloway for Galloways, Limited, the contractors for the boilers at Strawberry Road; Mr. H. Hawkins for W. T. Glover & Co., Limited, the suppliers of the cables; Mr. T. W. Fox for W. H. Bailey & Co., Limited, the suppliers of the jet condensers; Mr. W. L. Hockin for Alderman Holland; and Mr. W. Cobbett for Lacey, Clirehugh & Sillar, the consulting engineers. The questions referred to the inquiry are:—

1. As to the building of the Walness Works.

2. As to whether these works could have been enlarged (so as to use the machinery at present contained therein) sufficiently to supply electric current for the necessary lighting, and to run the tramways at the present time for the next five years.

3. As to the total power provided in the Walness Works and the new works, and if found to be in excess of the requirements to go thoroughly into the matter and report to the Council as to who is responsible.

4. As to all matters appertaining to any specifications, tenders, or contracts, in connection with the erection of Strawberry Road Station.

The Town Clerk (Mr. L. C. Evans) handed in the notice calling the meeting, and also the statements and charges made by Messrs. Hunt, Turner and Wheatcroft, and then recited a history of the whole of the Salford electricity undertaking.

Mr. Desquesnes said in Mr. Turner's notice were the words: "Some interested persons did cause by undue influence the alteration of certain documents." He wished to know to what this referred.

Mr. Turner said the documents referred to were in connection with the steam engine contract for the dynamos.

His Honour said here was a suggestion which was a very serious allegation against someone. Mr. Turner must assist him by telling him what the class of documents was, otherwise how were they to inquire into it? Against whom were they making this suggestion?

Mr. Wheatcroft said it was a document relating to the report made by Messrs. Lacey, Clirehugh & Sillar, with reference to the steam dynamos in September, 1899, and they alleged that that document was altered by someone connected with the firm, owing to influence brought to bear.

Mr. Wharton asked about Mr. Hunt's complaint against Alderman Shaw.

His Honour said the suggestion appeared to be that he was trading with a firm who were contractors to the Corporation. Why should that be stopped?

Mr. Hunt said, in the case of a member of the Corporation, it was possible for him to use his interest—he did not suggest Mr. Shaw had done so—in the direction of such firms who placed orders with him.

Mr. Wharton said the facts of the case were that Alderman Shaw had been a member of the Corporation for 22 years. In 1900 he was chairman of the Electrical Committee, but long before that his firm of John Shaw & Co. had been dealing with the predecessors of the St. Helens Cable Company for such things as engines and hydraulic machinery, and naturally they would be the people to whom they would apply for that sort of work. Between August 20th and the end of October the Corporation advertised for tenders for cable, and Mr. Shaw's firm continued their trading with the St. Helens Company. Messrs. Shaw supplied pumps to the St. Helens Company, but the pumps had nothing to do with the Corporation at all or with this inquiry. It was a mere incident and accident that their tender for pumps was accepted by the St. Helens Company during the time the latter were tendering for the cable.

His Honour: It only comes to this, "You sold a pump to a contractor who sold a cable for the Corporation."

Mr. Wharton asked the town clerk if the tender for the cable was not the lowest sent in.

Mr. Evans replied that it was £300 or more lower than the others, and handed in the record of the tenders.

His Honour said Mr. Hunt brought no charge of ill faith or illegality against Alderman Shaw, and therefore there was nothing for him to inquire into. The matter dropped, as it seemed to him Mr. Hunt did not dispute the statement of facts.

Mr. Hunt said he did not, and the subject was then dropped.

Mr. Hockin, for Alderman Holland, said the latter had been 18 years in the Council, and was a builder and contractor. He was chairman during the whole of the time that the Walness works were erected, and with reference to those works there had been no complaint, and that was mainly due to the fact that he was the chairman. He was not on the Electricity Committee, and all along he had been supplying bricks to Messrs. Cleworth & Robinson. They entered into a contract with the Corporation on May 8th, 1900, Alderman Holland not being at this time a member of the Electricity Committee. On May 11th, Alderman Holland was asked by Messrs. Cleworth & Robinson to quote the price of bricks, and the price quoted was 21s. 3d. per 1,000, which was the proper price. On June 20th Mr. Holland was placed on the committee, and he continued to supply bricks up to November 6th. About that time he saw something in the newspapers as to Corporation contracts in the neighbouring city, and he sought the advice of the town clerk. The latter advised him there was nothing illegal in his conduct and no violation of the law, but if he were in his place he would cease to supply the firm with bricks. That was very proper advice.

His Honour said this was a very different case to the first. It might be against the spirit of the Act.

Mr. Hockin contended that not a single brick was supplied to the contractors after that date. The correct price had always been charged, and the bricks were supplied for six months, thinking no harm was being done. Alderman Shaw had dealt with the firm 12 years. He was not on the committee, and had no voice in the contract at the time. From an ethical point of view, Mr. Holland admitted it was a mistake. He had not sold bricks to the firm since November 6th, and he thought it hard that Mr. Hunt should bring the matter forward.

Mr. Hunt: Mr. Holland had almost acted as a sub-contractor.

His Honour saw no illegality in what had been done.

Mr. Hunt said he accepted the statement made on behalf of Mr. Holland as setting forth the true facts.

This charge then dropped.

Mr. Wheatcroft then made his opening statement on the third clause of the subject. He urged that the Strawberry Road station was exorbitantly too large for the present and prospective requirements for the next five years. (Mr. Clirehugh: No, no.) He referred to the visits of deputations to Hamburg, and showed that there, with much greater requirements for all purposes—traction, lighting, &c.—for their population of 750,000, the grand total horse-power of the plant was 8,400, whilst for Salford's very much less requirements 10,750-H P. plant had been put down. Altogether, the plant was much in excess of the requirements. With regard to the boilers, they were decided upon after collaboration of the engineers with Alderman Sir R. Mottram and Mr. Howarth.

The latter objected, and the Town Clerk read the minutes of the meetings in the matter, which showed that before deciding upon the boilers the Committee, of whom Mr. Wheatcroft was one, had referred the matter for advice to Sir R. Mottram and the consulting engineers.

Mr. Wheatcroft then proceeded on Clause 4, and said he had a painful story to unfold, and one that was really repugnant to him. He would show that wheels within wheels were going on to a remarkable extent. He would show interference of certain parties with the consulting engineer, and that Mr. Turner, the former electrical engineer to the Corporation, that even Mr. Clirehugh became demoralised, and Mr. Turner's life became a difficult one, and it became impossible for him to retain an honourable course and keep his position with comfort. Mr. Turner's scheme was proceeding smoothly, when the committee became aware that outside interference was taking place. The chairman, Mr. Howarth, was being troubled by the representatives of a certain firm, and one firm in particular in October, November, and December, 1898. A climax was reached when Mr. Turner informed Councillor Boyes, the deputy chairman, witness himself, and others that he had had Mr. Norbury (a representative of Galloways) down to see him early one morning at the electric station along with the chairman of the committee (Mr. Howarth), and that pressure had been put upon him to specify for Galloway cross-tubular boilers, one reason assigned being that it was a delicate matter for them to tender direct, seeing that Sir Richard Mottram was in the Council. Mr. Turner did not comply, and then began trouble for him which he believed——

His Honour: I must say I am not interested in beliefs. Facts are important.

Mr. Wheatcroft said soon after that he saw Mr. Howarth, Mr. Turner being close by, and spoke to him about it. Mr. Howarth said, "Has Turner been telling you?" and at once called for Turner, and said to him he had better keep his tongue still. Mr. Howarth further told witness how he was pestered to death by Mr. Norbury and Sir Richard Mottram. He even told witness that he could not have a quiet game of cards at his club without notes being sent in. He also told Mr. Turner and witness he would not have it much longer, and if the interference continued much longer he would expose it. He asserted that Mr. Howarth also said in the committee room that something crooked was going on.

Mr. Howarth: That statement is an absolute fabrication.

Witness, continuing, could not say who was present. Mr. Boyes, the deputy-chairman, would be present, but he would not come to give evidence. He complained that a resolution was put in the agenda paper for the Council meeting of December 7th, 1898, recommending the appointment of consulting engineers, that had never been passed by the Council. This finally resulted in the appointment of Messrs. Lacey, Clirehugh & Sillar, the dismissal of Mr. Turner, and the acceptance of certain tenders. He alleged that this was due to influence brought to bear on the chairman by persons interested. He also complained that some of the members of the Committee were invited to meet the Iron and Steel Institute at luncheon by one of the firms tendering.

At this juncture a document was handed in by Mr. Wheatcroft, purporting to be a report prepared by a certain firm for the Committee, and kept back in the interests of another firm. Mr. Wheatcroft said he had it from Mr. Turner.

Mr. Desquesnes said this was the mysterious document about which so much had been heard, and nothing definite learned.

His Honour: It is obvious here is evidence of an important character. The suggestion is a serious one, and the document now turns up in the hands of one no longer a servant of the Corporation.

Mr. Desquesnes: What is the specific charge?

His Honour thought those concerned had better see it. It would have to be proved, and Mr. Turner would, therefore, give evidence to-morrow.

His Honour suggested that the town clerk have the document till the morning that the parties concerned might see it, but Mr. Wheatcroft demurred. His Honour then asked Mr. Cobbett and Mr. Desquesnes to act as his solicitors in the matter and be responsible for the document, but even then Mr. Wheatcroft was not willing to hand it over until his Honour initialled it.

The inquiry was adjourned until next morning.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—June 6th. Motors, pipework, chequer plating, &c. See "Official Notices" May 9th.

Beckenham.—June 6th. The U.D.C. wants tenders for incandescent lamps. See "Official Notices" May 16th.

Bermondsey.—June 16th. Main switches, cut-outs, distributing boards, electrical fittings, shades, conduits, &c. See "Official Notices" May 30th.

Brighton.—June 9th. Points, crossings, tie-bars, bolts, &c., for the Corporation tramways; also 300 tons of steel rails. See "Official Notices" May 9th.

Brighton.—June 9th. Supply of 300 tons of steel girder tram-rails. Particulars from Mr. T. B. Holliday, Lewes Road, Brighton.

Bristol.—June 20th. Pumps, water softener, filters and pipework for the electricity department. See "Official Notices" to-day.

Bury.—June 24th. Construction of permanent way for tramways. Particulars from Mr. A. W. Bradley, borough engineer and surveyor.

Denmark.—The Danish Telegraph authorities in Copenhagen have called for tenders for the supply of 78 tons of copper wire and 10 tons of steel wire.

Dudley.—June 6th. Tenders for the supply of incandescent lamps, and oil. See "Official Notices" May 16th.

Eastbourne.—June 6th. One dry-back marine type boiler and fittings. See "Official Notices" May 23rd.

France.—June 8th. The municipal authorities of Pradelles (Haute Loire) are inviting tenders for the establishment of a central electric lighting station in the town. Particulars may be obtained from, and tenders are to be sent to, La Mairie de Pradelles (Haute Loire).

Glasgow.—June 7th. Economiser and condensing plants. See "Official Notices" May 9th.

Glasgow.—June 7th. Supply of electricity meters for one year. See "Official Notices" May 30th.

Hoylake and W. Kirby.—June 9th. Tenders for electric lamps, oil, waste, &c., for 12 months. See "Official Notices" May 23rd.

Hungary. — September 1st. The authorities of Kolozsvár, in Hungary, want to introduce electricity for lighting and power purposes. See "Official Notices" May 9th.

Ipswich.—July 5th. Engines and dynamos, storage battery, overhead hand travelling crane, feeders, mains, &c., permanent way construction, and arc lamps. See "Official Notices" to-day.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Little Woolton.—June 20th. Laying and jointing of cables, supply and fixing of junction boxes and lamp connections, and supply of lamp fittings. See "Official Notices" to-day.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Manchester.—June 14th. Line materials for overhead equipment, trolley wire, &c. See "Official Notices" to-day.

Nuneaton.—June 18th. One water-tube boiler and connecting pipework. See "Official Notices" May 30th.

North-Eastern Railway. — June 9th. Telegraph apparatus and telegraph wire and line stores. Further particulars from Mr. Graves, Telegraph Department, York.

Rotherham.—June 17th. Tramway and lighting feeders, mains, &c., Lancashire boilers, and steam dynamo. See "Official Notices" May 30th.

Roumania.—June 13th. Tenders are being invited until June 13th by the municipal authorities of Calarashi—Stirbeiu for the concession for the electric lighting of the town during a period of 35 years.

Russia.—The Ouprava Company, Saratoff, Russia, asks for offers for a central power station for the production of electrical energy for public and private lighting, traction and motive power purposes.

Sophia.—June 9th. The Bulgarian Posts and Telegraphs Department wants tenders for the supply of telegraphic and telephonic apparatus.

Stockton-on-Tees.—June 17th. Boilers, condensing plant, steam dynamo, switchboard, mains, &c. See "Official Notices" May 30th.

Stretford.—June 18th. Tenders wanted for boilers, superheaters and economisers, steam dynamos, condensers, pumps and mains. See "Official Notices" May 23rd.

Swansea.—The Graigola Merthyr Company, Limited, are asking for tenders for electric lamps. Information from the company's offices, Cambrian Place, Swansea.

Tonbridge (Kent).—June 9th. Wiring electricity works. Particulars from Mr. R. Hammond, 64, Victoria Street, London, S.W.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

Warrington.—June 18th. Tramcars, with electrical equipments. See "Official Notices" May 30th.

Wellington (Salop).—June 25th. The U.D.C. invites applications for a lease of its electric lighting powers. See "Official Notices" to-day.

West Ham.—50 double-deck electric cars with equipments, for the Council. See "Official Notices" to-day.

Worksop.—June 17th. Low tension cables and joint boxes for the U.D.C. See "Official Notices" to-day.

Worksop. — June 10th. The U.D.C. will consider schemes for free or assisted wiring. See "Official Notices" to-day.

CLOSED.

Aberdeen.—The tender of Messrs. Carrick & Sons, of Edinburgh, for an overhead electric crane for the Dee Village Electricity Works, at a sum of £1,283, has been accepted.

Birmingham and Manchester.—Messrs. Dunlop and Company have accepted the tender of Messrs. Willans & Robinson, Limited, of Rugby, for two 250-H.P. engines for direct coupling to dynamos for electrical power purposes. The Chamber Colliery Company, of Hollinwood, have accepted the tender of the same firm for one of their standard compound engines for direct coupling to a dynamo for supplying power for electrical coal cutters and other motors about their colliery.

Dewsbury.—The contract for the erection of the car shed at Savile Town for the B.E.T. Co. has been given to Messrs. Garforth Bros., of Mirfield.

Dewsbury.—A Sub-Committee of the Corporation has been authorised to purchase another set of Bennis mechanical stokers for the electricity works.

London. — The Metropolitan and District Electric Traction Company, Limited, have placed the order for the storage battery for their electric traction scheme with the Electrical Power Storage Company, Limited.

Melrose.—The Roxburgh District Board of Lunacy have determined to light their asylum at Melrose with electricity. The plans and specification have been prepared by Dr. J. T. Bottomley, F.R.S., Glasgow.

Oldham.—The tender of Mr. S. H. Heywood, of Reddish, for the new switchboard for the Corporation has been accepted by the Electricity Committee.

Southwark.—For the supply to Southwark Borough Council of 1,000 incandescent lamps of the Ediswan, Robertson, or Zurich pattern :—

	Pattern.	For 2, 16, or 25-c.p., per lamp. s. d.	For 32-c.p., per lamp. s. d.
General Electric Co., Ltd. (*accepted*)	Robertson.	0 11½	1 2
Jackson Bros.	Ediswan.	1 0½	1 2½
Baxter & Gauter	,,	1 0½	1 2½
Edison & Swan	,,	1 1	1 3
Malcolm & Allen	,,	1 1	1 3
Royce, Limited	,,	1 2	1 5

Swansea.—The National Wiring Company has secured the contract for the wiring of the Free Library at £571.

Wigan.—The tender of Messrs. Dick, Kerr & Co. for generators has been accepted.

FORTHCOMING EVENTS.

Friday, June 13th.—At 3.30 p.m. Physical Society. Meeting at the National Physical Laboratory, Bushy House, Teddington.

At 9 p.m. Royal Institution. Extra Friday evening discourse will be delivered by G. Marconi, M.I.E.E., on "The Progress of Electric Space Telegraphy."

NOTES.

Peace!—In common with our readers, we rejoice in the successful termination of the war in South Africa. We look for a spirited revival of industry and trade, in which we trust our exporters are prepared to take the British Lion's share!

Civil and Mechanical Engineers' Society.—The annual dinner of this Society was held at the Restaurant Frascati on Thursday last week; Prof. R. H. Smith, the President, took the chair, and the guests included Lieut.-Colonel R. E. Crompton, Prof. Perry, Messrs. Middleton, Lee, Esson, Holroyd-Smith, and others, the total number being over 40. Replying to the toast of the "Imperial Forces," Lieut.-Colonel Crompton declared that Tommy Atkins was a thorough gentleman. Much benefit would result from the severe mental and physical training of the hundreds of thousands of men who had passed through the war; in future wars much would be done with mechanical traction. Mr. G. F. Emery, in proposing "The Society," stated that the membership now amounted to 135, and the accounts showed a surplus; Mr. B. B. Dudley replied, and drew attention to the fact that the Society had been in existence for 43 years. The energetic secretary, Mr. A. S. E. Ackermann, had added 50 members in the past two years. Replying to the toast of "Kindred Societies," proposed by Mr. J. Bridges Lee, Prof. Perry remarked that societies nowadays tend to grow too big and unwieldy; modest men do not care to get up to speak before such huge audiences, but they join for the sake of the commercial value of membership. Perhaps a roll of 150 members is better than one of 200 for real work. Pleasant musical interludes were provided by Messrs. Bartlett and Emery, members of the Society.

For Sale.—Our business pages to-day contain details of a proposed sale of transformers by the Newcastle-upon-Tyne Electric Supply Company.

Electricity in Mines.—In the House of Commons last week Mr. Markham asked the Home Secretary whether he would state the number of deaths that were directly due to the use of electricity in mines or shafts since May 2nd, 1901; and what course he purposed adopting to prevent this loss of life, in view of the development of electric power in mines. Mr. Ritchie, replying, said that the number of deaths in mines due to the use of electricity in the year 1901 were four in all—two caused by electric shock, and two by machinery moved by electricity. The use of electric power in mines is being carefully watched by the inspectors, and in due time he will be prepared to consider whether any steps ought to be taken with regard to it. There was no information as to the number of accidents caused by short-circuiting in mines, but the cases in which serious injury or loss of life had resulted had been very few. There was no power to require owners of collieries to report accidents caused by short-circuiting to the inspectors unless death or serious injury were caused or an explosion produced.

In his presidential address to the Institution of Mining Engineers, at Burlington House, Piccadilly, Mr. James S. Dixon, of Glasgow, said that in Scotland coal-working by machinery was making considerable progress. Last year there were 49 machines at work, which produced 485,584 tons. He estimated that the fuel consumed at the collieries last year would amount to 16,144,948 tons. By the application of electricity and high pressure steam improved engines he imagined that at least one-half that consumption could be reduced, and 8,000,000 or 10,000,000 tons of fuel saved to the country.

"Crown" Rail Bonds.—A pamphlet has been issued by the American Steel and Wire Co., which sets forth the virtues of the "Crown" rail bond; this, as is well known, has large terminals which are expanded into place by means of pins driven from the same side of the rail as the bond, no special appliances being required beyond a heavy hammer. The bonds are made both solid and flexible, and can be put either inside or outside the fishplates, or beneath the base of the rail. The "United States" bond is also described; this is flexible, and is designed to go into very confined spaces under fishplates. These bonds are made of copper strip, with welded, not cast, terminals, and are fixed with screw or hydraulic compressors, the terminals being solid. Numerous illustrations of bonds in position, &c., are given, with a number of practical hints to users of rail bonds.

Wireless Telegraphy.—In the current *Fortnightly Review* appears an article by Signor Marconi upon the "Practicability of Wireless Telegraphy." This article contains no new information upon the subject, being but a re-hash of that which has gone before. We notice that the application of wireless telegraphy at, amongst other functions, the International Yacht Race in 1899 is alluded to. Through some cause, however, no mention is made of the admitted failure of the system in the 1901 contest between *Shamrock II.* and *Columbia*, when, claims to syntony notwithstanding, three boats, fitted severally with different sets of apparatus, succeeded only in hopelessly confusing each other's messages shoreward. We venture to ask Signor Marconi one question:—Last month he announced that the system with which his own name is associated does not *now* (the italics are our own) necessarily depend upon the coherer principle. In our Italian contemporary, *L'Elettricista*, of May 1st, 1902, is described a new type of receiving instrument, not a coherer, the invention of Lieutenant Castelli, of the Italian Navy, and it is stated by our contemporary that this apparatus was employed in the late trans-Atlantic signalling from Cornwall to Newfoundland. We would ask, is this statement based upon fact, or did Messrs. Marconi use a coherer *with metallic filings* as the receiving instrument in those experiments, and also in the subsequent experiments between Cornwall and an outward-bound Cunard steamer, when signals were stated to have been received on the vessel nearly all the way across the North Atlantic? A direct answer upon this point from the Signor or his technical adviser will be of interest.

The Ibero-Americano Society.—The celebration of the twelfth anniversary of this society took place at the Hotel Metropole on Saturday evening last. Like all the festivals that have hitherto been given under the auspices of the Ibero-Americano, as the society is familiarly known to a circle of favoured people in London, this banquet and social evening was a repetition of many previous successes. The company was numerous (over 200 being present) and distinguished. After the reception, the assembled guests sat down to a menu which was *recherché*. A well-conducted and efficient bijou orchestra discoursed sweet music during the repast, Spanish airs giving an additional charm to the ear. The toast of the evening, "The Ibero-Americano Society," was cordially received, and responded to by the chairman, Ed. R. P. Moon, Esq., M.P. A capital concert was most charmingly rendered during the latter part of the evening. The Ibero-Americano Benevolent Society does not appear to have been called upon to relieve distress to any great extent during the past year, having, according to its report, expended only some £237 in relieving some 157 applications, and the society has a respectable balance in hand of £1,890. We wish all success to the Ibero-Americano, and may its potentiality for doing good, and aiding in the cause of charity, ever remain to fulfil the purposes of its organisation.

Coronation Energy.—The Corporation electrical engineer at Blackpool advises us that energy is to be supplied gratis for outside illuminations (providing that no new service connection on the underground mains is necessary) to existing consumers. Bare cost of special connections to be charged. Municipal buildings are to be electrically illuminated.

Electro-Harmonic Society.—The statement of accounts presented to the annual general meeting of this society on Wednesday last shows total receipts £268 10s. 11d., expenditure £206 6s. 6d., leaving a balance of £62 4s. 5d., a very satisfactory condition. During the past (sixteenth) season 64 new members have been elected, 32 have resigned; the total membership now amounts to 358.

A Good Example to Manufacturers.—The Nottingham University College has received a number of gifts which will be of great utility in illustrating the construction of dynamos and machinery, in connection with the engineering classes. These gifts are from Messrs. Siemens Bros. & Co. and the Callender Cable and Construction Company.

Electrical Treatment of Peat.—At Stangfjorden, in Norway, a factory for the treatment of turf by electrical methods has been erected. The turf is first dried and formed into blocks by pressure, the water contents in this way being reduced to 20 per cent. The dried blocks are then enclosed in retorts, and heated to the requisite temperature by internally placed resistance coils. A gas useful for heating and illuminating purposes is obtained, while a tarry liquid also distils over, which can be worked up for paraffin, ammonium sulphate, and methyl alcohol. The turf charcoal remaining in the retorts is a useful substitute for either wood charcoal or gas-coke. The electrical installation at Stangfjorden comprises five 128-H.P. turbines, direct-coupled to five dynamos of equivalent size and capacity. The current from these is used for heating the retorts, while a separate turbine supplies the requisite mechanical power. The 12 retorts are designed to deal with 1,000 centners of air-dried turf per day, and 400 KW. are now utilised in this manufacture.—*Commercial Intelligence.*

Institution of Electrical Engineers.—The deputation to the President of the Board of Trade, which was fixed for yesterday, has again been necessarily postponed. Mr. Balfour expressed his regret at having to inconvenience the deputation a second time, but he had no means of foreseeing the urgent public business that quite unavoidably led to the postponement.

DUBLIN LOCAL SECTION.—The committee reports that it has communicated with the Department of Agriculture and Technical Instruction for Ireland, with regard to the collection of data as to the available water-power at different seasons of the year, and as to suitable sites. The total membership has increased to 66.

Electrocuting Old Horses.—The New York *Electrical World* prints the following cablegram:—"No wonder horses are so frequently electrocuted in Paris. Three clever swindlers were arrested this week in the act of leading a worn-out hack to a spot where they had previously unscrewed a cap at one of the electric 'plugs,' where the animal was to meet its doom. The practice was proved to be an habitual one. An old hack is bought for a mere song, led to the death trap, and a heavy claim for damages is served upon the tramway company. The chief culprit is a former tramway employé."

Appointments Vacant.—Demonstrator in electrical engineering for the University College, Nottingham; instrument maker (£100) for the Royal Technical Institute at Salford.

Marriage.—On 3rd inst. Mr. C. E. Hodgkin, of Purley Lodge, Reading, late director of the Brush Electrical Engineering Company, and now of the Pulsometer Engineering Company, was married at Goring-on-Thames, to Miss Alice Jane Brooke. The REVIEW tenders its hearty congratulations and good wishes to Mr. and Mrs. Hodgkin.

Arc Lamps.—We are informed by Messrs. Drake and Gorham that the litigation which has been conducted between the Jandus Company and the Davy Construction Company for some years past, with reference to the alleged infringement of the Jandus Company's master patents, has been brought to a close. The Davy Construction Company are stated to have taken a license from the Jandus Company.

Personal.—Mr. J. B. C. Kershaw, F.I.C., has opened a laboratory at "The West Lancashire Laboratory," Waterloo, Liverpool, where he intends to make a special feature of fuel and fuel gas analysis. In a recent letter to the *Engineer* (May 2nd) on fuel economy Mr. Kershaw showed how the chemist can aid the central station engineer in the improvement of boiler efficiency. He concludes his letter by saying that waste of fuel can be prevented by careful attention to the character of the fuel supply and to the composition of the waste gases passing up the chimney.

Mr. Charles Gerhardi has resigned his position as manager of the Direct Spanish Telegraph Co., and the directors have appointed Mr. Fred. Thos. Preddle as secretary.

Mr. W. R. C. Wakley, A.M.I.E.E., on Saturday, May 31st, was presented on his resignation with a handsome marble clock and an illuminated address, signed by more than 30 of the men who worked under him during the nine years he held the appointment of chief engineer to Messrs. Maple & Co.

Mr. David Robertson, B.Sc., lecturer of Electrical Engineering at the Bradford Municipal Technical College, and formerly assistant lecturer at the Glasgow and West of Scotland Technical College, has been elected to the vacant chair of electrical engineering in the Merchant Venturers' Technical College, Bristol.

Prof. Arnold Philip has resigned the post of Professor of Electrical Engineering and Applied Physics in the Merchant Venturers' Technical College, which he has held since 1896, on his appointment to a position in his Majesty's Dockyards at Portsmouth.

The Light Railways Congress.—For the occasion of the twelfth International Tramways and Light Railways Congress, which opens at the Agricultural Hall on Tuesday, July 1st, a large number of visits and excursions have been arranged, as follows:—

Visit to: The City & South London Electric (Tube) Railway, running north and south, and the power station.
The Central London Electric (Tube) Railway, running east and west, and the power station.
The Waterloo & Baker Street Electric (Tube) Railway, running north and south, in course of construction.
The London United Tramways, electric trolley system, and power station.
The London County Council Tramways, conduit system, in course of construction.
The Islington (London) Municipal Electric Lighting Station. The Congressists will be received by the Mayor and Aldermen, by whom they are invited to luncheon.
Messrs. Crompton's Electric Works, Chelmsford, about 30 miles east of London.

In addition to the above, arrangements are in progress for visits to the following and other places:—

The Bankside Electric Lighting Station, in London; the Westminster Electric Station; the Westminster Hydraulic Power Station; Messrs. Siemens's Electric Works, at Erith, on the Thames; Doulton's Pottery Works.

On Saturday, July 5th.—Those members who find it convenient to remain in London will be invited to a lengthened excursion to one of the industrial centres in England, probably Wolverhampton. Particulars of this will be sent later on.

On Sunday, July 6th.—Mr. Murphy, chairman of the Dublin Tramways, has invited members who may proceed to Ireland to go over his line and inspect his power station.

Belleville Boilers Again.—Shall we never get rid of the Belleville boiler? As though to attempt still to cover their error, we now find published as a Government paper a letter of Messrs. Delaunay, Belleville & Cie, commenting on the *Minerva-Hyacinth* report. In face of the recent statement in the House that even the Messageries Maritimes were discarding this boiler, the present letter comes curiously at an opportune moment. It shows how hard it is to kill the boiler's friends; of course, the writers of the letter being the makers of the boiler, have reaped a rich haul from this country, and, doubtless, do not wish to lose its custom. But it is really too much for a French firm to ask Great Britain to go on indefinitely crippling her navy for a French boiler. The letter before us practically contradicts all that the Boiler Commission had to say, and takes up a few points to endeavour to prove how good the boiler is. As we have always contended, a boiler may make dry steam, and it may make plenty of it, but it may not be a safe boiler, and nothing can justify its use. The writers of the letter profess to have discovered all about the leakages, but they have not a word to say of the hogging of tubes of all Belleville boilers, which proves over-heating. Grave mischief was done by the Admiralty continuing to fit Belleville boilers for a whole year after the preliminary report of the Committee had condemned them, and this fact is made much of in this letter. It is difficult to get at the whole truth of the Navy boiler question. A huge blunder has been made, and those responsible have taken every care to get a very easy let-down. There is certainly an impression abroad that concerning the Belleville boiler troubles, the half has not been told to us. We think that if the Boiler Commission had only put out the whole truth, it would have been better for all concerned, and might have saved such letters as the one before us.

THE CENTRAL STATION ENGINEER.

Mr. W. Jensen has recently been appointed resident engineer and manager to the Chatham and District Light Railways Company, having been previously engaged at the Corporation Electricity Works at Croydon. Before he left Croydon he was the recipient of a handsome gold watch chain and engraved medallion from the staff and employés, as a token of their high appreciation of his valuable services.

CITY NOTES.

Northern Counties Electricity Supply Company.

The first annual meeting of this company was held on May 27th at Newcastle-on-Tyne, Mr. John D. Milburn, the chairman of the company, presiding. The chairman moved the adoption of the report, of which a summary has already been given, this was seconded by Admiral Cleveland and carried unanimously. The chairman then gave some interesting particulars as to the efforts of the company. He said the Blyth works which were to supply Blyth and Cowpen were started in December; about 140 consumers were already connected, and they had numerous applications for power for different industries. The Spennymoor works had been connected about a week. They had nearly 250 customers, representing about 3,100 8-c.p. lamps, and they were making steady progress. With reference to the two places the early success of their operations had been largely due to the adoption of the penny-in-the-slot meter and free wiring, which enabled small customers who did not wish to go to the expense of wiring their own houses to take advantage of the electric light. The Alnwick station was nearly completed, and they hoped that the generating station would be open about July. Every effort was being made to complete Hebburn and Felling works before the winter. They had secured the whole of the public street lighting and were going to introduce the free wiring system so that the shipyard workers could have the light in their cottages. Under this system by the payment of 1d., 5½ hours' lighting could be obtained from each 8-c.p. lamp installed. Other works were in progress at Shildon and Handsworth, and their other areas included Consett, Shotley Bridge, Thirsk, Malton, Barnard Castle, Annfield Plain, Leadgate, Stanley, &c. The Northumberland Electric Tramways Bill which was being promoted by the company had passed the House of Lords unopposed, and they trusted it would pass the Commons without serious opposition. Having thus reviewed the field of operations in detail, the chairman said the directors were of opinion that, in view of the large population contained therein (350,000 to 400,000 people), the number of works, factories, mines, and the prospects for electric traction in certain portions of the area, the company should have before it a satisfactory career.

The retiring directors, Messrs. John D. Milburn, and Arthur Scholefield, were re-elected, as were also the auditors, Messrs. Strachan & Co.

The meeting terminated with a warm tribute to the company's engineers, Messrs. C. W. Fairweather, and C. S. Vesey-Brown.

Mexico Electric Tramways Company.

The report for 1901, to be presented at the meeting at Winchester House on 11th inst., states that from January 1st, 1901, the system has been worked by their company under the terms of the lease entered into with the Compania de Ferrocarriles del Distrito Federal de Mexico. A net balance is shown to the credit of profit and loss account of £16,662. After paying the preference dividend there is £4,500 available, which, together with £2,227 brought forward, makes £6,533 to be carried forward. During the year a further 200,000 6 per cent. cumulative preference shares of £1 each has been issued at par, in order to provide the necessary funds for construction purposes, leaving 112,987 shares still unissued, the proceeds of which will be devoted to construction and further extensions. The company's service now extends over 251 kilometres of track. The number of passengers carried during the past 12 months was 26,709,225, being an increase of 39,165, and the receipts amounted to £209,136, an increase of £5,259, which was partly made up of increased freight returns. The operations during the year did not, from perfectly unavoidable causes, realise the anticipations of the directors. The past year has been one of the worst in the commercial history of Mexico. The outlook, however, is distinctly encouraging.

Merthyr Electric Traction and Lighting Company.

The directors' report to be presented at the meeting at Donington House, W.C., at 11 o'clock noon, on Thursday, June 12th, reads as follows:—

The directors beg to submit their report and statement of accounts for the year 1901. The total capital expenditure to December 31st, 1901, amounted to £86,859 9s. 3d. The gross receipts on the tramways from April 6th (the date upon which the lines were opened for traffic) to December 31st, 1901, amounted to £9,567 3s. 4d., and the gross receipts on account of electrical supply from July 22nd, amounted to £2,104 17s. 8d., making with £80 3s. 9d. sundry receipts, a grand total of £11,772 4s. 9d. After deducting expenses, amounting to £7,129 6s. 9d., and £1,434 12s. 3d. for debenture and other interest, there remains a net profit of £3,208 5s. 9d. The directors propose that this amount should be applied as follows:—

To pay dividend on the cumulative preference shares to December 31st, 1901	£862 10 0
To be placed to reserve and depreciation fund	1,000 0 0
To dividend on the ordinary shares at the rate of 4s. per share = 5½ per cent. per annum	1,200 0 0
To be carried forward to next account	145 15 9
	£3,208 5 9

The number of private electric supply consumers now connected with the mains represent a demand equivalent to 4,313 lamps of 8-c.p. This department of the business continues to make satisfactory progress. Mr. J. S. Raworth, Mr. C. S. Drummond, Mr. Geo. Stevens, and Mr. R. Percy Sellon, have resigned their seats on the board. Mr. C. G. Tegetmeier and Mr. G. Ratcliffe Hulme have been appointed directors of the company. The directors regret the deaths of their colleagues, Mr. D. F. Sugrue and Mr. J. Slater Lewis. Mr. Emile Garcke is the director retiring by rotation, and being eligible, offers himself for re-election.

Miles Open:—	1901.
Route miles	2·98
Single line	2·22
Double line	·76
Number of passengers carried	1,619,704
Average receipts per passenger	1·41d.
Number of cars in stock	16

Prospectuses.

The Anglo-American Debenture Corporation, Limited, have purchased £120,000 5 per cent. first mortgage debenture stock of the Colombo Electric Tramways and Lighting Company, and have offered for sale on their own behalf £100,000 of that stock at par. The Colombo Company has acquired the electric tramways and lighting business at Colombo, previously carried on by the United Planters' Company of Ceylon, Limited. The company has been formed for the purpose of separating the electrical undertaking from the tea-planting business carried on by the old company. The tramways (seven miles of double track) were constructed in 1898 on the overhead system. The electricity supply business is progressing satisfactorily, and is capable of large extension.

The British Insulated Wire Company has been offering for subscription at par £250,000, balance of an issue of £500,000 4½ per cent. first mortgage debenture stock. The new capital is required for the development of the amalgamated businesses of the British Insulated Wire Company and the Telegraph Manufacturing Company.

Letters of allotment in connection with the Charing Cross and Strand Electricity Supply Corporation, Limited, issue of 40,000 4½ per cent. (City undertaking) preference shares, 1902, of £5 each at par have been posted.

Western Telegraph Company.—Interim dividend, payable on June 24th, of 3s. per share, or at the rate of 6 per cent. per annum, for the quarter ended March 31st, 1902. The transfer books will be closed from June 17th to 23rd.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 30th were £841; corresponding week last year, £846; decrease, £5. Total to date, £14,644; corresponding period last year, £12,897; increase, £1,747. Miles of track open, 11½.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 31st were £671; corresponding week last year, £1,863; decrease, £1,192. Total receipts to date, £6,898; corresponding period last year, £6,993; decrease, £95.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 30th were £4,676; corresponding period last year (Whit week) £6,597; decrease, £1,921.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending May 28rd:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	469	—	—	20½	8,005	—	—
Dudley–Stourbridge	1,177	517	—	20½	13,955	2,614	—
Gateshead¶	829	413	—	20½	13,393	735	—
Greenock-Pt. Glasgow	512	295	—	20½	8,527	4,830	—
Hartlepool	366	136	—	20½	4,255	417	—
Kidderminster ..	214	95	—	20½	2,147	228	—
Merthyr†	276	38	—	20½	3,980	—	499
Middleton*	374	—	—	5½	2,485	—	—
Oldham–Ashton ..	607	87	—	20½	9,842	87	—
Poole†	849	85	—	20½	4,425	76	—
Potteries	1,718	278	—	20½	28,686	1,333	—
Southport	483	319	—	20½	3,500	1,205	—
South Staffordshire†	1,096	328	—	20½	15,344	914	—
Swansea	564	139	—	20½	8,643	892	—
Taunton*	88	—	—	20½	1,166	—	—
Tynemouth§	392	155	—	20½	4,287	358	—
Wolverhampton Dist.	801	247	—	20½	2,922	1,929	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ¶ Comparison from May 8th only.

Central London Railway.—The receipts for the week ending May 31st were £6,815; corresponding week last year, £6,368; increase, £447. Total receipts to date, £147,483; corresponding period last year, £136,471; increase, £11,012. Miles open, 6.

City and South London Railway.—The receipts for the week ending June 1st were £2,952; corresponding week last year, £1,822; increase, £1,130. Total receipts to date (22 weeks), £65,422; corresponding period last year, £43,434; increase, £21,988. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—The receipts for the week ending May 31st were £246 18s. 10½d.; corresponding week last year, £289 9s. 3½d.; decrease, £42 10s. 5d. Total to date, £4,066 12s. 0d.; corresponding period last year, £3,950 9s. 6½d.; increase, £116 2s. 5½d. Miles of track open, 3. Car miles run, 1902, 5,253; 1901, 5,134. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending May 30th were as follows:—D.U.T. Co., £3,861 8s. 6d.; D.S.D. Co. £1,909 9s. 9d.; total, £4,770 18s. 2d.; corresponding week last year—D.U.T. Co., £4,108 13s. 4d.; D.S.D. Co., £1,011 2s. 5d.; total, £5,119 15s. 9½.; decrease, £348 17s. 6d.; aggregate to date, £91,963 18s. 10d.; last year, £87,816 8s. 1d.; increase, £4,147 10s. 9d. Mileage worked, 46.

East Ham Tramways.—The receipts for week ending May 31st were £479 7s. 6d.; total to date, £17,99? 7s. 5d. Number of cars, average 18.

Liverpool Overhead Railway.—The receipts for the week ending June 1st were £1,481; corresponding week last year, £2,079; decrease, £59[illegible]. (1901 includes Bank Holiday.) Total to date £31,368; corresponding period last year, £34,455; decrease, £3,087. Miles open, 6 miles 67 chains.

Sunderland Corporation Tramways.—Week ending June 1st, £1,040; corresponding period last year, £1,525. Total receipts to date, £9,619; corresponding period last year, £8,767. Miles open, 17·89.

STOCKS AND SHARES.

Wednesday Evening.

Now that the long-expected has happened and Peace is declared, Stock Exchange markets are sinking back into something like lassitude. After those few hours of frantic excitement last Monday, when Consols touched 98 and Kaffirs boomed ahead, a natural reaction has fallen upon the House, and Derby Day was welcomed as affording a fair excuse for leaving business to take care of itself. The outside public shows no disposition whatever to rush in and buy things generally, so that the heavy profit-taking which succeeded the proclamation of Peace had but little buying resistance offered to its onset. Markets, after their three weeks of eager expectation, are mostly quiet, and as one broker put it, all the "fizz" is out of them.

Stiffening rates in the discount market point to the possibility of a higher Bank Rate, and the number of calls which fall due this month are not calculated to bring ease to Lombard Street. The electrical departments supply a good many of the demands for cash in calls, and with the prospect of several large power companies coming soon, to say nothing of other undertakings, the floating amount of loanable capital may easily shrink to comparatively small proportions. The little Bromley (Kent) Electric issue does not, of course, make any difference to the money market, but it is hailed as a possible precursor to a number of other concerns of similar type. If all prospectuses were as clean and free from "pickings" for promoters, the average investor would be much better off. The small amount offered for subscription, however, precludes any active market from being made in the stock and shares.

The telegraph list makes rather a better showing this week by reason of the subdued strength of both Eastern and American descriptions. Eastern Ordinary has risen three points, and Eastern Extension 4 per cent. Debenture has recovered its last week's decline. Eastern Extension shares do not move, and are still well above the comparative price of Eastern Ordinary stock. Besides being better held, the fact that Eastern Extensions are shares, while the other is stock, may account for some of the divergence in prices. The investor as a rule loves shares. At least, he is credited with more affection for security in that form than in stock. Anglo-American Deferred has lost a fraction, but Commercial Cable bonds, upon buying from New York, have put on five points, the quotation once more standing at 160. Great Northern Telegraph shares are £1 down, but Indo-Europeans do not move. For the latter there are only buyers in the market, and the dealers have a string of purchasers' names on their books whom they cannot accommodate with shares. West African Telegraph shares are good at 4, having lost no time in justifying the suggestion made, when the price was 2, that they were better worth attention than many of the mining ventures in the "Jungle" Market. The rise is, of course, due to the reported sale of part of the company's undertaking to the French Government. But the 5 per cent. Debentures do not move, and if any can be secured they would make a good selection for averaging the yield obtained from a list of higher-grade securities.

The Electrical Supply section remains quiet, and there is not much business doing in its shares. City of London Preference are down ½, and Edmundson's Debentures have gained a point; these are the only two fluctuations worthy of mention. Charing Cross and Strand are unaltered upon the appearance of the new "City Undertaking" shares. These last-named have not established themselves in the market so far, but appear to be well enough secured. Central Electric Supply 4 per cent. Debentures are firm at 106 *ex* dividend, and, indeed, the cry of the dealers is still that there are not enough Debenture stocks to go round for the purchasing public. Primitiva Gas and Electric Lighting of Buenos Ayres are attracting a little attention, and business is being done in the £5 Ordinary shares at about 2⅜, while the Preference are 4, and the 4 per cent. First Debentures at 93 are just *ex* the coupon. Argentine shares of all classes are coming into favour upon the happy settlement of the country's differences with Chili, and another instance of this is to be found in the buying of Buenos Ayres and Belgrano Tramway shares. The Ordinary are nearly 1¾, and both the Preferences have 5 as their middle figure.

London United Tramways Debenture stock is very strong at 107½, and Westinghouse Debenture commands 4 premium, while the Preference shares are 5¾. North Metropolitan Trams are being done at 4½, and Calcutta Trams, *ex* the right to apply for new shares, are 13. Anglo-Argentines are good at 4 1/16, although the Stock Exchange Official List playfully quotes them as 4⅛ to 4.

Electrical railway stocks are led by Central London Ordinary with a rise of 1, and some of the major prophets are talking hopefully of an increased dividend on the stock. City and South London Third Preference is harder at 122½, and business was marked in this stock on Tuesday at 124½. Great Northern and City Preferred shares do not budge from 8½.

In the miscellaneous market, British Insulated Wire and Telegraph Manufacturing are both ½ down, and from what we can hear, the recent issue of Debenture stock was not brilliantly successful, although the security seems sound enough. General Electric Preference shares are better, the presence of a buyer serving to disclose the shortness of shares for sale, while Brush Ordinary have enjoyed a fresh spurt; the buying had all the appearance of inspiration. Henley's are ½ down, but the decline has nothing to do with the dividend which it is expected will be shortly declared.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations May 28th.	Closing Quotation June 4th.	Business done during week ended June 4th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	44 — 47	44 — 47	...	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	88 — 90	88 — 90	89½	88
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7 — 7½	6¾ — 7¼	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	160 —170	160 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	93 — 96	94 — 96	95½	...
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	9½— 10½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 —102	99 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	10⅜	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	117 —127	120 —130	124½	120
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	86 — 89	86 — 88	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	106 —110	107 —112	...	...
360,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	12½— 13½	12½— 13½	13½	12⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	106 —110	107 —112	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	99 —102	99 —102 %	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	8 — 9	8 — 9	8 1/16	8⅜
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13½	13 5/16
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	26 — 28	25 — 27	26	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	40	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	96⅜	96¼
200,000	Do Pref. shares	2	...	3⅛	3⅜	3¼— 3⅜	3¼— 3⅜	3 5/16	...
1,966,667	Do Def. Stock	100	...	60	64 xd	53 — 57	53 — 57	56	54
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	94 — 97	96	95½
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	103 —107	103 —107	105½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16 xd	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4½— 5	4½— 5	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½— 12½	12 3/16	...
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	...	...
88,321	West India and Panama Telegraph	10	4%	...	...	⅛— ⅜	⅛— ⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½— 4½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	¼— ½	¼— ½	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	8¾— 9¼	9 — 9¼	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¾— 9¼	8¾— 9¼	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9½	9¼
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106¼	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5¼%	4 %	5 — 5⅛	5 7/16— 5⅛	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	110 —113	110 —113	111¾	111½
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	11½ — 12½	11 13/16	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	125 —128	123 —128	126	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	7½— 8½	7½— 8½	8⅛	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —111	110¼	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6¼— 6⅝	6¼— 6⅝	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	108 —111	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	10½	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	96¼	95
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	16½— 17½	16½— 17½	17	16⅞
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15 3/16	14 13/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 3½	3 — 3½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11 — 12	11 — 12	11¼	...

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation May 28th.	Closing Quotation June 4th.	Business done week ended June 4th, 1902. Highest.	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	86 — 90	86 — 90	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13½ — 14½	13½ — 14½	14 3/16	14⅛
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12⅝	12⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126¼	126
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	8 — 9	8½ — 9½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 5⅝	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	Nil	⅜ — 1¼	1⅛ — 1⅜	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1⅜ — 2¼	1⅜ — 2¼	1⅞	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	101	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	95 —100	95 —100	95	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17 — 18	17 — 18	17 1/16	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	6	5⅞
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	104 —106	106⅛	105½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	105	102
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	100 —103	101½	...
855,000	City and South London Railway	Stock	1¼ %	1¼ %	2 %	71 — 74	71 — 74	74	71¾
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	103 —108 %	103 —108 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	2 — 3	...	...
844,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	75 — 80	75 — 80	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½ — 1⅝	1½ — 1⅝	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜ — 10¼	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	98 —101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	17 — 18	16½ — 17½	17	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅝	21⅜
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	101¾	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾ %	3¼ %	1½ %	4 13/16 — 4 15/16	4 13/16 — 4 15/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½ — 11	10½ — 11	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ —16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	34 — 37	34 — 37	36¼	35
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	103 —106	103 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10 — 11	9½ — 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	92 — 95	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—3/16.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅞—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, June 4th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	23/-	23/-	..
a " Oxalic	per cwt.	39/-	39/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammonia, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a " " ..	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C),	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a " Caustic (76/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	110/-	115/-	5s. dec.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb.	2¼d.	2¼d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal Ingots	per ton	£40 to £110	£40 to £110	..
c Brass (rolled metal 2" to 13") basis	per lb.	6⅞d.	6⅞d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c " " (solid drawn) ..	per lb.	7d.	7d.	..
c " Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8⅝d.	8⅝d.	..
c " " (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g " Rod	per ton	£69	£69	..
e " Electrolytic) Bars ..	per ton	£63	£63	..
e " " Sheets ..	per ton	£75	£75	..
e " " Rod ..	per ton	£68	£68	..
e " " H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	6/-	6/-	..
h India-rubber, Para fine	per lb.	3/11½ to 3/0½	3/0½	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	49/8½	49/6	2½d. inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i " Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 10 to £11 12 6	£11 12 6	dec.
g " " Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p " rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p " " strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9J. to 1/-	9J. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i " " in bars		£58	£58	..
g Tin, block	per ton	£134 10 to £135 10	£135 to £136	10s. dec.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 16	per lb.	1/8	1/9	1d. dec.
p White Anti-friction Metals —				
"White Ant" brand	per ton	£36 to £60	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j " 6 lea. Flax	per lb.	5⅞d.	5⅞d.	..
j " 3 ply 10 lbs. Russian ..	per lb.	4 15/16d.	5 15/16d.	..
j " 10 lbs. Russian, single ..	per lb.	4¾d.	4¾d.	..
j " 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh't. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

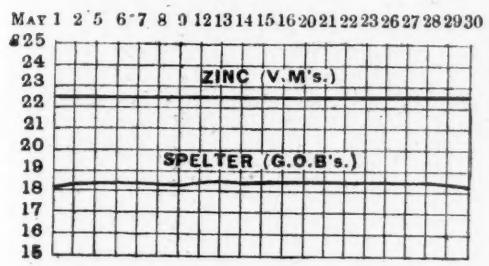
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

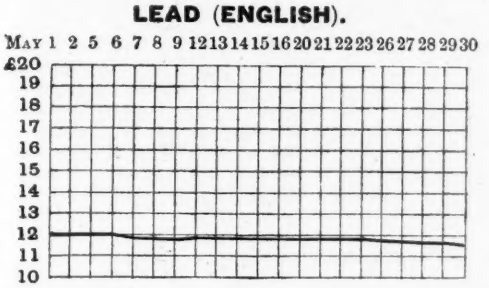
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. R. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

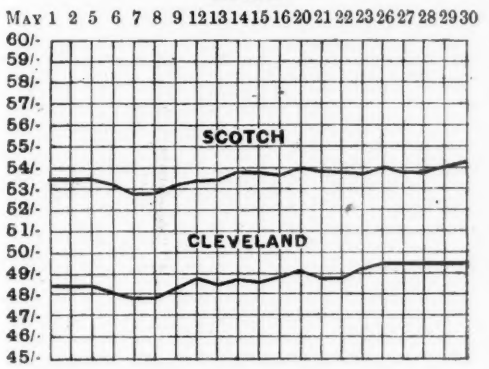
METAL MARKET.—Fluctuations in May.



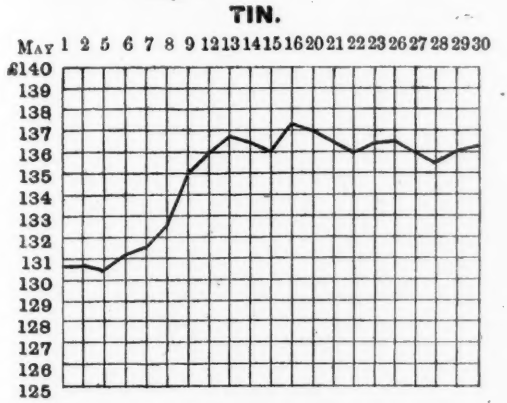
LEAD (ENGLISH).



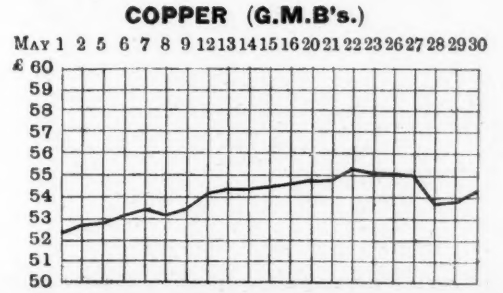
IRON.



TIN.



COPPER (G.M.B's.)



INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE MACHINERY.

By A. C. Eborall.

(Paper read at Manchester, March 25th, 1902.)

(*Continued from page* 916.)

This section of the paper may be concluded by giving some further particulars relative to the large polyphase generators illustrated in figs. 2 and 3; these particulars, used in conjunction with the details and dimensions shown on the various drawings, will enable the respective designs to be worked out by those interested in such matters.

Schedule II.

Three-phase Fly-wheel Generator of 4,000 kw.

(See Fig. 2).

Output (cos ϕ = 1)	4,000 kw.
Terminal pressure	6,500 volts.
Current per phase	355 amperes.
Revolutions per minute	75
Frequency	50 cycles.
Number of magnet poles	80
Peripheral speed in feet per minute of magnet wheel	5,900
Diameter of armature bore	300 in.
„ over field poles	299¼ „
Air gap length (iron to iron)	0·375 „
Gross width of armature core	29·125 „
Net width of armature core (10 per cent. paper)	21·5 „
Depth of armature core	10 „
Total number of armature slots	480 „
Dimensions of these (open) slots	(2·187 × 0·625) in.
Number of conductors per slot	2
Nature of armature connection	Star.
Dimensions of pole cores	(29·125 × 4·25) in.
Dimensions of pole shoes	(29·125 × 7·5) in.
Thickness of polar laminations	0·04 in.
Number of turns per pole core	30
Nature of field winding	Copper strip.
Dimensions of field conductor	(1 × 0·16) in.
Weight of the complete magnet wheel without shaft or slip rings	110 tons.
Weight of the complete generator without shaft or bearings	188 tons.
Excitation loss at full load (cos ϕ = 1)	20 kw.
„ „ (cos ϕ = 0·85)	32 „
Efficiency of generator excluding friction and ventilation losses:—	
At full load (cos ϕ = 1)	97·2 per cent.
At half „ „	96 „
At full „ (cos ϕ = 0·85)	97 „
At half „ „	95 „
Full load pressure drop (cos ϕ = 1)	7·5 „
„ „ (cos ϕ = 0·85)	18 „
Highest temperature rise of any part after continuous running for 24 hours at full load (355 amperes)	65° F.

Schedule III.

Two-phase Fly-wheel Generator of 3,500 kw.

(See Figs. 3, 4 and 5.)

Output (cos ϕ = 1)	3,500 kw.
Terminal pressure	11,000 volts.
Current per phase	160 amperes.
Revolutions per minute	75
Frequency	60 cycles.
Number of magnet poles	96
Peripheral speed in feet per minute of magnet wheel	5,860
Diameter of armature bore	300 in.
Diameter over field poles	299·05 „
Air gap length (iron to iron)	0·475 „
Gross width of armature core	29·1 „
Net width of armature core (10 per cent. paper)	21·5 „
Depth of armature core	7·2 „
Total number of armature slots	576
Dimensions of these (open) slots	2·19 × 0·69 „
Number of conductors per slot	10
Nature of armature connection	Star.
Section of oval pole cores	80·5 sq. in.
Dimensions of pole shoes	(29·1 by 6·55) „
Number of turns per pole core	33
Nature of field winding	Copper strip.
Dimensions of field conductor	(1 × 0·217) in.
Weight of the complete magnet wheel without shaft or slip rings	88 tons.
Weight of the complete generator without shaft or bearings	178 tons.
Excitation loss at full load (cos ϕ = 1)	17 kw.
Full load pressure drop (cos ϕ = 1)	6 per cent.
Highest temperature rise of any part after continuous running for 24 hours at full load	70° F.

STANDARD POLYPHASE MOTORS.*

Synchronous Motors—

The characteristic properties of a well designed polyphase motor of this class are :—

(*a*) It must be brought up to full speed, suitably excited, and then synchronised, before being switched on the circuit.

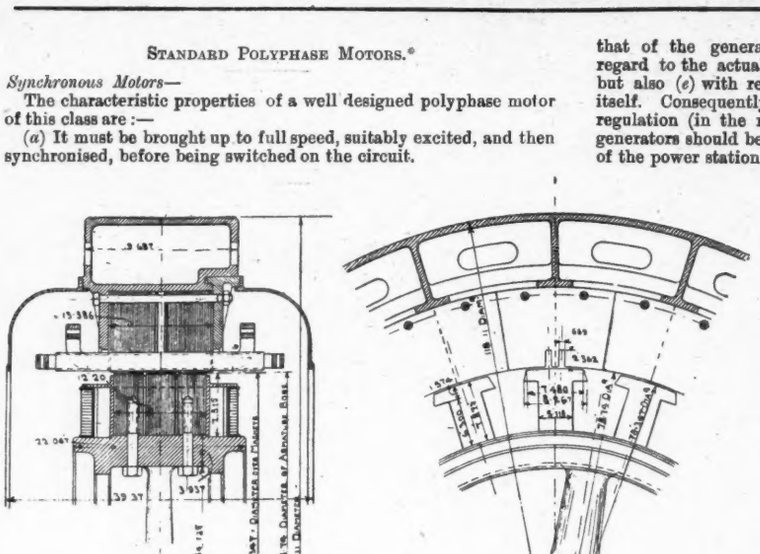


FIG. 16.—PRINCIPAL DIMENSIONS OF TWO-PHASE SYNCHRONOUS MOTOR.

(*b*) The power factor of the motor can be made to have a value of approximately 100 per cent. at all loads by making slight changes in the excitation of the field system.

(*c*) By making further changes in the field excitation—that is to say, by over-exciting the motor after it has been paralleled—it can be made to operate under full load with a heavy leading current.

(*d*) At constant frequency the speed is constant; it can only be commercially) varied by changing the frequency.

(*e*) The running of the motor is affected by the cyclic irregularity of the prime movers in the generating station.

(*f*) The efficiency of the motor is high over a wide range of load, and its overload capacity, before falling out of step (under suitable conditions of operation) is all that can be desired.

It follows from (*a*) that, unless the load of a synchronous motor consists of a direct current generator, which can be used as a starting motor, an auxiliary starting motor must be provided. This can be directly coupled to the shaft of the main unit, and be either an asynchronous polyphase motor, or a direct current motor. The latter is, on the whole, preferable, and can sometimes be conveniently used, for, in any case, direct current must be available for the excitation of the synchronous machine. It is preferable because the speed of the combination can be more readily adjusted for synchronising, but there is not a great deal in this.

Formerly such synchronous motors were sometimes arranged to be self-starting by throwing them upon the line through auto-transformers; this implies solid pole shoes, or else suitably arranged dampers. As synchronous motors are invariably of medium or large size, such a crude method of starting is highly objectionable, on account of the heavy starting current of low power factor taken from the mains, which is bound to affect the pressure regulation of the system. For this reason, the method in question is hardly ever used nowadays.

With regard to (*b*) and (*c*), this property of the synchronous motor is of the greatest value, for it means that the system from which the synchronous motor is operating can be maintained at a high power factor throughout; the lagging currents caused by asynchronous motors, arc lamps, &c., connected to the system can be mostly balanced out by the leading currents taken by a few synchronous motors distributed over it. Or, for instance, the pressure drop on a long transmission line can be compensated for; it is perfectly feasible to arrange matters in such a way that the pressure at the receiving end of the line is equal to that at the generating end. It will not pay to do this as a rule, unless the load at the receiving end of the line is inductive; in this case a reduction in the amount of the line loss is brought about. If the load at the receiving end is non-inductive, the compensation for the drop naturally results in an increased line loss.

When synchronous motors are used as boosters or compensators in this way, in addition to being used as motors, they must, of course, be built larger than would otherwise be necessary, for they have to carry the boosting or compensating current and flux, in addition to the load current and the flux actually required for the load; the increased dimensions of the motor necessary for this are, however, not considerable, and even when very large boosting or compensating effects are desired, the increased cost of the synchronous motors, when viewed in the light of the good results attained, is small in comparison.

Regarding (*d*) the constancy of speed of the synchronous motor is a very solid advantage in the class of work for which such machines are generally used. The speed varies in the same proportion as that of the generators in the power station, not only with regard to the actual number of revolutions made in a given time, but also (*e*) with regard to the speed variation in the revolution itself. Consequently, it is of the first importance that the speed regulation (in the revolution) of the prime movers driving the generators should be as close as possible; if the cyclic irregularity of the power station generators is such that the phase displacement of the generators exceeds certain permissible limits (in accordance with what has already been stated), hunting of the synchronous motors may be set up. Dampers on the field poles of synchronous motors are of considerable assistance in this connection—in fact, if the pole shoes of the motors are laminated, and if the motors are of large size and operated from slow speed generating plant, such dampers are a necessity. In general, the fly-wheel effect of the rotating part of synchronous motors should be as small as possible—under these circumstances the motor can more readily follow the changes in the frequency, and it is more under the control of the dampers should these be used.

The properties of synchronous polyphase motors are well illustrated by the test curves given in fig. 17, which have been placed at the disposal of the author, together with the constructional data of the large two-phase motor in question, by the Oerlikon Company, of Zurich. The sketch given in fig. 16 gives the leading dimensions of this motor, and further data are given in the schedule below:—

SCHEDULE IV.

Two-phase Revolving Field Synchronous Motor of 900 *B.H.P.*

Rating	900 B.H.P.
Terminal pressure	2,600 volts.
Full load current per phase (cos $\phi = 1$)	135 amperes.
Revolutions per minute	276
Frequency	46 cycles.
Full load input	700 KW.
Number of field poles	20
Nature of field winding	Copper strip.
Number of turns per field pole	40
Section of field conductor	(1·38 × 0·12) in.
Total number of armature slots	160
Number and arrangement of the conductors per slot.	Six conductors each consisting of three wires in parallel.
Diameter of these wires, bare	0·174 in.
" " covered	0·2 in.
Flux per pole at no load	5·1 megalines

Referring to the test curves of this motor, shown in fig. 17, these are as follows :—

Curve A.A.—No load characteristic curve—it shows the relation between the field excitation in amperes and the terminal pressure at no load and normal speed.

Curves B.B. and C.C.—Load characteristic curves for 700 KW., showing the above relations when the armature currents are 135 and 170 amperes respectively, the power factors of these loads being 100 per cent. and 80 per cent. respectively.

Curve D.D.—Short circuit characteristic curve—it shows the relation between the field excitation in amperes and the current per phase of the armature when both phases are short circuited.

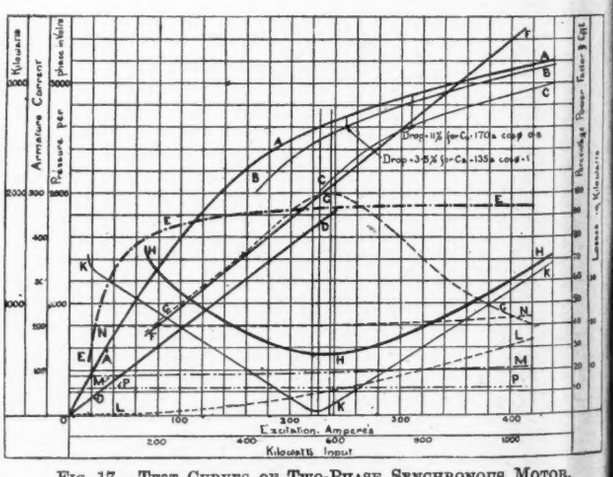


FIG. 17.—TEST CURVES OF TWO-PHASE SYNCHRONOUS MOTOR.

NOTE.—The four curves above were taken with the machine running as a generator.

Curve E.E.—Efficiency curve expressed as a function of the input of the motor.

* It has been found necessary to curtail this section of the paper very considerably, as otherwise, owing to the unavoidable length of the generator section, the paper as a whole would have been too long.

Curve F.F.—Curve of maximum output. This curve shows the relation between the excitation in amperes, and the maximum loads expressed in kilowatts that the motor will stand before falling out of step corresponding to these excitations, expressed in kilowatts; the curve, therefore, gives the maximum loads which can be obtained from the motor with given excitations. For a definite value of exciting current, the maximum load of the motor is approximately equal to the terminal pressure multiplied by the value of short circuit current corresponding to this excitation.

Curve G.G.—Power factor curve—it shows the relation between the exciting current and the power factor at a constant load of about 900 B.H.P. on the motor, corresponding to an input of 700 KW. at 2,600 volts.

Curve H.H.—V curve for a load of about 900 B.H.P. (input of 700 KW. at 2,600 volts); it shows the variation of the armature current per phase with the excitation at constant load.

Curve K.K.—V curve at no load and 2,600 volts impressed pressure.

Curves L.L., M.M., N.N., and P.P.—These curves show the relation between the input of the motor and the copper loss, excitation loss, total iron losses, and friction and ventilation losses respectively.

The very complete information given with regard to this typical motor will enable those interested to make a complete study of the characteristic properties of this very interesting class of polyphase machine.

The natural field of application of such synchronous polyphase motors is clearly that in which constant speed, maximum power factor, and (perhaps) leading currents are of importance, and where starting torque and the cost of special starting arrangements are of little importance. Thus for large sub-station work such motors are excellent, being, as a rule, very much superior to the corresponding sizes of asynchronous motor for driving direct current generators, as for this work the starting up and synchronising can be readily arranged for. Again, in connection with large power distribution schemes, it is generally far better to use synchronous motors for all large work (say above 200 H.P.) for which they are adapted, for quite apart from the question of power factor, such motors are, on the whole, preferable from the mechanical point of view. The synchronous motor of large size works with a reasonable clearance instead of with the exceedingly small amount absolutely necessary with the induction motor, and the large starting box necessary for the latter (which must be mounted near the motor itself) together with the necessary heavy rotor wiring, slip rings and brush gear, are not required.

Of course there are many purposes for which large motors are required that are quite unsuited to synchronous machines, such as pumping and similar work; moreover, for all small and medium powers, the induction motor must be used. But for certain classes of heavy mill work, for instance, there is no objection whatever to the synchronous motor, and a few large motors of this type, used on a system supplying many smaller induction motors, will go a long way towards improving the power factor of the whole system.

(To be continued.)

AUTOMATIC RELAY TRANSLATION FOR LONG SUBMARINE CABLES.

By S. G. Brown.

(Paper read in London, May 1st, 1902.)

The system of relay working for long submarine telegraph cables here described must not be looked upon as being in an experimental stage. It is in everyday use on some of the lines of the largest cable companies, notably those of the Eastern Telegraph Company, their station at Gibraltar having been the first to be fitted up for automatically translating cable messages between Porthcurnow in England and Alexandria in Egypt.

The usual method employed on cables at the present time is to receive signals on a strip of paper, written by a siphon recorder, as a dotted ink line. The message at an intermediate station is then punched by hand on another strip of paper, which is passed through an automatic transmitter for retransmission over the next line. Or, if the speed of signalling and the conditions of the circuit will allow of it, the message is read off the siphon recorder strip by the clerk, direct, as it flows from the instrument, and sent on by a hand key, signal by signal. The latter system is termed "human translation," the speed being necessarily limited by the possible rate of hand transmission, and it is slow, laborious, and permissible at only one station. A cable relay is, therefore, valuable in that it replaces the clerk in all these operations, receiving and sending on the traffic automatically, whatever may be the speed of transmission. I believe the provision of a submarine cable relay has been one of the problems, to the solution of which the attention of telegraph engineers has been turned for some years. The requirements in such an instrument are great sensitiveness, combined with the capability of being worked at a high speed by the feeble forces available at the receiving end of a long cable, and the absolute assurance of perfect contact. With the exceedingly feeble current obtainable at the end of cables, when operated at their present working speed on the siphon recorder, it is useless to bring two pieces of metal into "butt" contact with the view of closing the circuit of a battery, so as to work, say, a Post Office relay, since the resistance of such a contact may be normally many thousands of ohms, whilst, if the local battery is increased so as to break down this resistance, the contact on passing a current coheres or sticks together and prevents the cable current from opening the circuit.

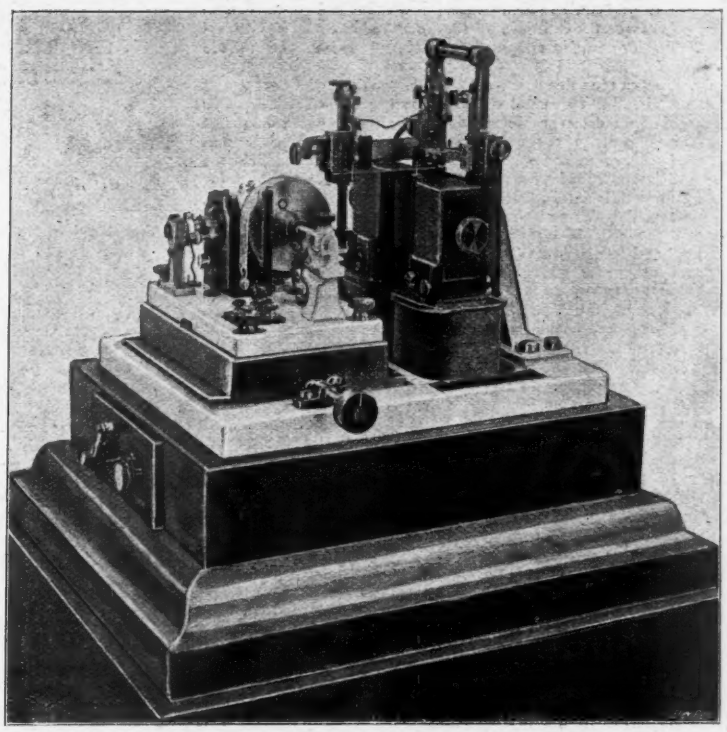


Plate 1.—"Drum" Cable Relay.

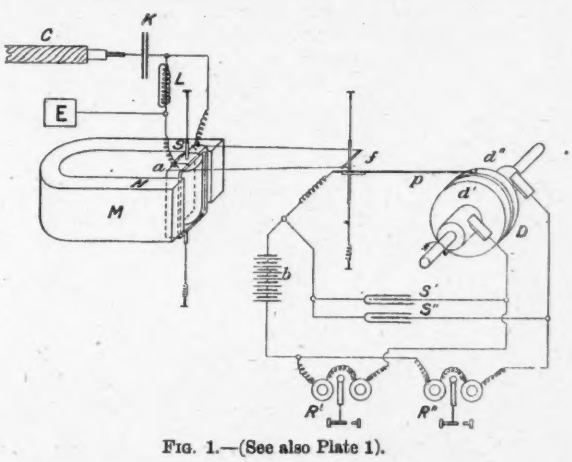


Fig. 1.—(See also Plate 1).

This disturbing force, although a great drawback in sensitive relays, has been effectually made use of for purposes of wireless telegraphy.

Varley, in his patent No. 3,456 of 1862, proposes to get over the difficulty of the relay contact sticking after the passage of the current by revolving the contact pieces, but I have found by actual experiment that such a movement actually increases the trouble of making contact, so that, on the whole, the remedy is as bad as the disease. I have found, however, that with such a form of relay, the resistance of the contact could be reduced by the use of a suitable short-circuiting condenser.

About the early part of the year 1899 I discovered that good electrical contact could be made and maintained by keeping the

end of the relay tongue pressed upon the surface of a divided plate, and that frictional resistance to side motion of the tongue could be reduced and almost eliminated by moving the plate under the tongue, or what amounts to the same thing, by moving the tongue over the surface of the plate, the movement in each case being maintained in the direction of the length of the tongue. To obtain the best effect and greatest sensitiveness, the relay tongue is arranged in practice to move across the surface of a rotary drum; the drum is divided into insulated sections, and the sections joined to Post Office or similar relays. This relay is called the "drum cable relay."

In fig. 1, *a* is a recorder coil suspended in the field of a permanent magnet M; *f* is a light suspended frame to carry the relay tongue *p*; the frame is joined to the suspended coil, *a*, by two silk or quartz fibres. The pointer, *p*, is a fine siphon glass tube carrying through its bore a phosphor-bronze wire. This wire is soldered to an iridium tip, which tip is shellacked to the extreme end of the siphon tube. The iridium tip bears lightly upon the surface of the drum D, which is kept revolving at about 150 revolutions per minute. The drum, D, is made in three parts: the two outer ones, *d' d''*, constitute the "dot" and "dash"-marking surfaces, and the middle one, upon and in the centre of which the pointer normally rests when no signal or current passes, is insulated. When the tongue is deflected by the movement of the coil to form, say, a dot, a circuit is made through the battery *b*, the tongue *p*, and the Post Office relay R'. A movement of the tongue in the opposite direction would close the circuit of the Post Office relay R''.

The relay depends for its efficiency upon the reduction of frictional resistance to the lateral movements of the tongue, and it is easy to prove that this effect is due to the tangential motion of the surface, for if the drum is stopped when signals are being received, the tongue also comes at once to rest, since the currents leaving the cable are of insufficient strength to overcome the statical friction between tongue and surface. This principle is somewhat ignored, I am afraid, in most treatises on friction; might there not be a parallelogram of friction corresponding to that which we use in dealing with force and motion?

"S' S''" are condensers of 2 microfarads capacity each, used to short-circuit the sliding contact between the tongue, *p*, and the drum *d*. Without them, good electrical contact can only be maintained when the surfaces of the drum and the tongue are very much cleaner than they can possibly be kept in practice. Why these condensers do improve the contact, making the contact practically perfect, I am not prepared to say. One eminent electrician maintains that this proves the existence of a vibratory contact. We all know why a condenser improves a vibratory contact, but I hardly think this touches the root of the matter, because I find that when the surface of the drum is exceptionally smooth the value of the condenser is usually more pronounced.

K is the receiving condenser. This condenser is placed in the circuit to act as a curb to the signals and to block out earth currents. The current from the cable, *c*, passes through this condenser before flowing round the suspended coil, *a*, to the earth plate, E. The placing of the condenser, K, in the circuit introduces a difficulty due to its becoming charged under a succession of signals of the same polarity, producing what is termed "Variable Zero." This variability of zero, which, unless special means are provided for its elimination, always occurs in cable signals when receiving condensers are employed, is of little or no importance if the siphon recorder is used as the receiving instrument, but is fatal to the working of a relay of any form.

Whilst experimenting with Mr. A. L. Dearlove at Porthcurnow, on the Gibraltar—Porthcurnow cable of the Eastern Telegraph Company, the variability was got rid of by placing a high resistance shunt across the receiving and transmitting condensers, but this method was not found quite practical owing to the fact that earth-currents were not entirely excluded by the shunted condensers. The consequence was that the earth-current temporarily upset the adjustment of the relay, and this mode of working was objected to by the company. For this reason I devised another method, which in practice has been found entirely satisfactory. I shall explain it here as briefly as possible.

"Variable zero" may be got rid of by means of "local correction," that is to say, a current from a local battery and the relay, R' R'', is sent through a circuit having considerable retardation made up of a condenser placed between two high resistances, the condenser and resistances being capable of minute adjustment. The relays, R' R'', produce the same order or combination of signals as that charging up the condenser, K. As the current from the cable, due to this choking action of the condenser, dies away, so at exactly the same rate does the current from the local correction circuit increase. The correction current flows through a separate winding on the suspended coil, *a*, in the same direction as the signals, so as to compensate for the loss of current from the cable, thus eliminating "variable zero" disturbances entirely from the working of the relay.

L is a magnetic or inductive shunt of 30 ohms resistance, joined across the terminals of the suspended coil, *a*. The shunt can be adjusted to suit cables of from 1 to 10 K.R.; the largest size at present used has a very high self-induction. I am not at present prepared to say what the value is. It is secured by the use of many thousands of turns of copper wire, and a heavy closed magnetic circuit. The mechanical arrangement of this shunt is on the lines of the well-known "Mordey" transformer.

Roughly speaking, to get high inductance to deal with the slow changes of current from a cable, we must have weight. Our largest shunt turns the balance at something like 3 cwt. When operated by the cable currents from the end of a line, the iron of the shunt must be magnetised only in its initial stage, the molecules being magnetically strained well within their elastic limit. In support of this statement, I shall refer you to Prof. Ewing's book on "Magnetic Induction in Iron and other Metals," Chap. VI., from which the following is more or less a quotation.

(To be continued.)

ON THE DETERMINATION OF THE IRREGULARITY FACTOR OF ENGINES.

By Dr. RUDOLF FRANKE.

A Paper read before the Verband Deutscher Elektrotechnicker at Dresden.

Translated from the *Elektrotechnische Zeitschrift*, October 24th, 1901.

(*Continued from page* 898.)

In fig. 5 I show another simple piece of apparatus, based on the idea of the Hefner von Alteneck belt dynamometer. The machine A, with the irregular motion to be tested, is connected by a rope S

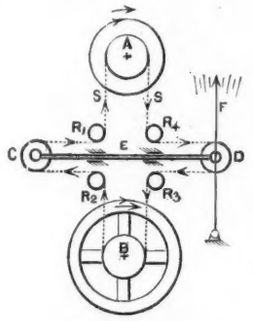


FIG. 5.

with the uniformly rotating mass B. The rope, S, is at the same time carried over the fixed pulleys R_1, R_2, R_3, R_4, and the loose pulleys, C, D, connected together by the rod E. As soon, therefore, as a difference in speed arises between A and B—A gaining on B, for instance—the rope in the span, A, R_1, C, becomes tight, and that in the span, A, R_4, D, loose to the same extent, and a motion of the pulleys, C, D, in the direction, C, D, will consequently take place. This motion is recorded by means of a pencil, F, on a drum moving below. The motion of the pulleys, C, D, represents half the difference in motion between A and B. This apparatus, which can be fairly simply constructed, served me for a considerable time in some interesting observations on the working of gas motors; for actual measurements it is not to be recommended, owing to the presence of the elastic rope, which naturally is a source of errors that cannot be eliminated.

I heard, in the summer of 1899, through the kindness of Dr. Göpel, of a piece of apparatus constructed by that gentleman at the Physikalisch-Technischen Reichsanstalt, belonging to the same class, which enabled a record of an irregular motion to be taken in an unusually simple manner. Its principle was somewhat as follows:—

A vertical spindle with a horizontal disc attached to it was driven by the machine under test with an irregular motion. A massive disc was supported on three balls above the first disc, and was carried round by rolling friction and gradually brought to a quite uniform steady speed. The upper surface of the massive disc was provided with a sheet of paper, and a pencil, firmly connected to the vertical irregularly rotating spindle, could be moved over the paper from the outer periphery of the disc to the centre point. In this way the pencil recorded the difference between the irregularly rotating spindle and the uniformly rotating disc in the form of a curve, whose axis of abscissæ would, in the ordinary course, be a radius of the disc. The vertical spindle was driven from the engine by a silk thread.

As, however, with this arrangement, simple though it be, slipping is not avoided, and as, further, in consequence of the radial motion of the pencil the amplitudes of the waves of the curve of motion diminish towards the centre, the method cannot be said to be free from objection nor to give any great degree of accuracy.

This arrangement of Dr. Göpel's induced me to construct the apparatus shown diagrammatically in fig. 6. A horizontal spindle, A, is connected with the machine under test; a heavy cylindrically-shaped mass, B, is supported on ball bearings, and is easily movable round A. This mass is first brought up to the average speed by means of the removable carrier C, and is then left to itself. A pencil, D, can be drawn across the drum from left to right, parallel to the axis, A, by means of a frame, E, which is rigidly connected to the spindle, A, and consequently moves with the same irregular motion as the latter. For this purpose a small train of wheels is put into action at the right instant, and a thread, F, is thereby wound up on the drum, T, and so produces the motion of the pencil. This

apparatus is connected to the engine by means of a rigid coupling, which is at the same time easily disconnected, and thus elastic alterations are as far as possible avoided. As the markings of the

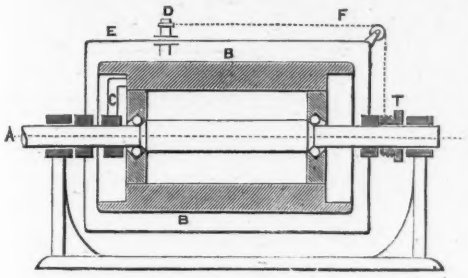


Fig. 6.

pencil occur on a cylindrical surface the amplitudes are practically all equal. This apparatus has served for the most varied observations, and has worked without trouble on the whole, though for small irregularity factors, its sensitiveness is insufficient. In order to increase the latter, it is only necessary to increase the peripheral speed of the drum, and this can be done either by increasing the diameter of the drum or by inserting a train of wheels between the engine and the drum. Both methods have been tried. In the first case the dimensions become so large as to make the apparatus unwieldly, and, in consequence of the large centrifugal forces, deformations result which cannot be avoided. In the second case one has to consider the irregularity of the teeth of the wheels, not to mention play in the wheels which might, however, be obviated by the use of a small brake on the spindle, A. On these accounts

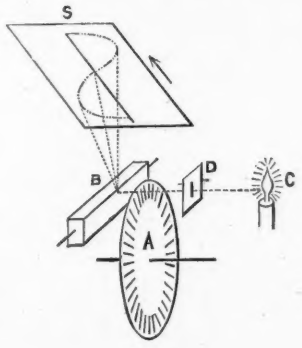


Fig. 7.

this form of apparatus was also not investigated further. In order to avoid the above-mentioned defects, the arrangement shown in fig. 7 was hit upon, in which the curve was recorded by means of a ray of light. A disc, A, having slits cut round the periphery is connected with the irregularly rotating engine. A system of mirrors, B, is uniformly rotated in such a way that as soon as the disc has moved on two slits a new mirror has taken the place of the first. A beam of light is thrown from the source, C, through the diaphragm, D, and the slits in the disc, A, on to the mirror, B, and from there it

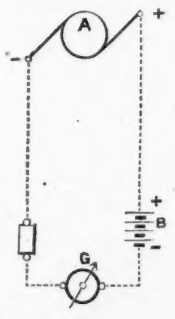


Fig. 8.

is reflected on to the screen, S. If now the disc rotates irregularly relatively to the mirror, B, the beam of light will move from left to right. And if, at the same time, the screen is moved in the direction indicated by the arrow, this motion of the beam of light can be photographically recorded in the form of a curve. This method, however, also failed to lead to any useful results, partly because of its want of accuracy and partly because of its inconvenience.

It does not seem possible to me, after the above-mentioned attempts, to further improve this class of apparatus. It is quite suitable for instructional purposes, but of no value for accurate measurements.

It now only remains for us to consider methods belonging to Class 3, in which the irregularity factor is determined by measurement of velocity. Apparatus working by the aid of centrifugal force—*e.g.*, tachographs—cannot be used because of their sluggishness and want of sensitiveness; I will therefore entirely exclude these from consideration. We can, however, determine velocities with far greater accuracy by means of the arrangement shown in fig. 8. A continuous-current machine, A, is rigidly coupled to the engine under test, and its E.M.F. with constant excitation is then proportional to the instantaneous velocities. If now the dynamo E.M.F. is compensated by a counter E.M.F., B, corresponding to the average E.M.F. of the dynamo, A, and therefore also to the average angular velocity, the currents passing through the galvanometer, G, will be proportional to the differences between the two E.M.Fs. Throws are therefore set up in the galvanometer which correspond to the variations of the irregular velocity.

(To be continued.)

THE BRITISHER AT HOME.

[Communicated.]

It seems strange to the writer, who has just returned home after some years' absence abroad, to find his countrymen under the influence of a "scare," which appears to him quite unjustifiable.

According to the preaching of that portion of our Press, whose pessimistic wail strongly suggests the far-reaching influence and business acumen of "the enterprising drummer from across the pond," poor old Britannia is, in the very near future, to be severely relegated to the background of commercial and manufacturing obscurity, whilst our American cousins flash the seachlight of civilisation on the path of advance and allow the effete Britisher to follow in her footsteps and pick up the crumbs they may leave for her if there should be any.

It is difficult to estimate the injury inflicted on the nation at large by the propagation of such a pernicious idea amongst the loafing as well as what may be termed the working classes, whose untrained minds are ever ready to accept as gospel any wild statement which implies discredit to ourselves or afford them some fancied ground of complaint against a Government, which, at its worst, is still the best in the world, and would be accepted as such by the staunchest "pro-Boer" or Home Ruler amongst us if it were "boomed" with only one-hundredth part of the pertinacity and patriotic enthusiasm displayed by the Americans over their own form of government.

The following remarks, based not upon hearsay, but on intimate personal experience, will, we hope, assist the small manufacturer and the general reader whose experience has not been broadened by travel, to more correctly estimate the soundness of his country's relative position in the world, and encourage him to contemplate the advances of our competitors from the logical standpoint of common sense, and not from the sensational and artificial point of view so persistently urged by the interested partisans of our energetic American cousins, whose "hustling" propensities are never so enthusiastically engaged as when "getting up a scare" either here or at home.

The apparently well accepted statement that all American machine shops and factories are filled with automatic high-speed machinery of the very latest design, which as soon as it can be improved upon it is at once consigned to the scrap heap, with electric motors driving cold rolled shafting working in self-oiling and self-adjusting roller bearings, with elaborate arrangements for tool maintenance and supply, and so on, is only true within certain narrow limits.

Large establishments such as the Westinghouse, the Baldwin Locomotive Works, the Western Electric, the Springfield Small-arms, Singer Sewing Machine, and similar establishments, may answer to the above description, but the average American factory is not one whit superior to one of a similar class at home, save in devices for labour saving, to which we refer later on.

The writer has in mind several shops of prominence and good standing, employing from 100 to 500 or more hands in the production of a variety ranging from door hinges to special machines of tons weight, where all dimensions are sent to the pattern shop or the forge simply scrawled with

pencil on a scrap of paper, or with chalk on the back of a door, or anything else convenient. Some of the most beautiful and important results in telephonic enterprise ruling the exchanges of nearly the whole world, have been worked out by similar crude methods and made on machines no better than those to be found in small shops at home 40 years ago.

Brand new shops like those quoted are designed for an output essentially limited to its own specialities, and are not fair representatives of general American machine shop status. They work under the ægis of combination and a high protective tariff, with an enormous capital, which allows them to buy up or ruin, by process of law, every patent bearing on its product, not for its amelioration or development, but to be held in reserve for the suppression of competition. Thus fostered, they can afford to supply themselves with magnificent, specially designed automatic machinery for the output of articles, whether twist drills or locomotives, within strictly defined limits, the high cost of which machines renders it necessary that the consumer should be compelled to adapt his wants or his system to the capabilities of the machine or material which the shop has the sole right to provide him with, rather than that the manufacturers should be compelled to alter their expensive plant so as to provide the consumer with a more suitable product.

Until very lately American engineering concerns have had only their own country to supply, and found the field large enough without seeking an outside market, and if with the aid of a high protective tariff the American can tax his own people sufficiently to allow him to supply us with the surplus of his production at less than cost price, it is rather a matter for our self-congratulation that we are not in a position to return him the favour.

Our position is very different. We have to supply the whole of the civilised and most of the savage world, not in the wholesale and uniform manner in which the American workshops supply themselves, but in detail to suit many comparatively small markets, whose requirements are ruled by wide variations in climate, geographical position, soil, labour, transport and purpose.

Much stress has been laid on the neatness and lightness of American machine design. But it must be remembered that designing a machine or piece of constructive work which has only to be loaded on a truck on a shop siding and from thence taken direct to the point of delivery for use by trained hands, is quite a different thing from designing that same machine or work when it has to be transhipped perhaps more than once in an open roadstead, and then dumped down on a sea beach to await transport of the crudest kind to its final destination, where skilled labour is rarely to be had and the means of repair are of the most primitive. Such machinery or material requires a solidity and freedom from complication and a sub-division of parts which may give it a somewhat crude and clumsy appearance to the uninitiated, but in practice it fulfils the aim of its designer, which is that it should stand up to its work and show scarce a sign of wear under treatment and conditions which would reduce a machine of American design to little pieces.

Passing over our avowed superiority in marine engines, we will touch on the much discussed subject of American *versus* English locomotives. To compare one of our highly finished, compact and beautifully proportioned locomotives with the gaunt, unfinished and apparently emergency built American locomotive, is as fitting as to compare a marine chronometer with a Dutch cuckoo clock, and this is the verdict of all nations who have tried them both. Our aim is to build a locomotive which will do the hardest work that can be got out of it for the longest possible time. The American argument that their locomotives are only built to last until they are superseded by something better, is to assert that it is more economical and therefore better engineering to build two or three weak and inferior engines in the place of one good one. It is owing to this theory, no doubt, that their maintenance accounts are so much greater than our own, and fully accounts for the serious accidental loss of life on American lines which for many years was attributed to that mysterious "fatigue of metals" which in this country was held to be synonymous with bad material and insufficient cross-sectional area. On some of our main lines, and on many of our branch lines, engines which were built 35 or even 40 years ago, are still doing good work both as to load and speed, and to say that these engines should be consigned to the scrap heap because of the date on their name plates, is childish. If a long life of hard work is the true test of an engine's worth, which is incontestible, then it must be admitted that our engines are superior to the American in proportion to the length of their relative lives.

Again, any fancied superiority which may be claimed for American railway travel is not due to want of brain power or enterprise on our side, but to the simple fact that conditions with us do not exact the same facilities or luxury. Our national characteristic is not extravagance. Their fast special trains on the great lines surpass anything of the kind in the world. Nothing that money or brain can achieve has been left to do. In a country where the restless activity of its people prompts them to undertake a week's railway journey with as little forethought as we would give to one of three or four hours, such sumptuous provision of comfort is indispensable. With us such travelling is unknown, because it is impossible; and there is no reason for us to excel therein or to regret that we cannot equal it. On the other hand, anyone who has had the painful experience of travelling on the ordinary short trains or the cross-country connecting lines of America, or who has watched the passing of the locomotive over the half round ties of an unballasted road and seen the spikes whose duty it is to hold the rail down, drawn from and return to their holes with its rise and fall under each wheel, will be forced to admit that travel of the ordinary kind in America possesses elements of discomfort and danger which are absolutely unknown on our cheapest and worst managed lines, and it is highly indicative of American good humour and philosophy that they cheerfully submit to treatment on the part of the employés, against which the average Briton at home would most vigorously rebel.

The reason for this state of things is that if they had to wait until finances allowed better construction or organisation, they would have to travel in the primitive ox cart or mule stage.

Not long ago we were told that the immeasurable superiority and low price of American clocks and watches were to sweep our watch factories off the earth. No such superiority exists, and Clerkenwell still lives. America still calls on us for all her best timing, repeating and high class watches. First-class watches can be bought cheaper here than there, and of better quality. For marine chronometers we are not equalled by them nor any nation, and the same may be said of first-class pendulum clocks. A portable, reliable eight-day clock is not to be found in America unless it be either of European make, or a home-made abomination with two springs which require a stronger wrist than most women possess to wind up, and is in no sense a timekeeper.

The raw one-day nickeled drum clock, and the dollar watch are, we allow, marvels of ingenious reduction of mechanism and price, but they are not wanted here, and no reason exists why we should compete in making them. From time immemorial we have had all our towns, churches, cathedrals and other public buildings provided with large clocks, all striking the hours, and but few not striking the quarters and chimes on bells which could be heard for miles. Some of the most beautiful of these are in small villages, and suffice for all household and out-door timekeeping.

In America, where villages and towns sprung up like mushrooms, and were often abandoned as quickly, there was no town clock available, and therefore the cheap watch and the house clock of the Sam Slick order was a necessity for everyone indoors or out, and the demand was met with true American promptitude. It is the peculiarity of conditions beyond our control, and not want of brain or enterprise, which places us out of the running in the supply of ultra cheap clocks and watches, and there is no reason to regret it.

We can well allow our American cousins the palm for the invention or construction of light machines, such as typewriters, sewing machines, carpet sweepers, mechanics' hand-tools, and similar articles. Their scarcity of labour compelled the invention and use of such long before we were aware of their existence, but superiority in these articles by no means implies superiority, or

even their equality in other branches. No such perfect shops or factories as we possess for the production of heavy work such as armour plates, marine engines, artillery or ship building exist in America, nor are they our equals in making submarine or underground cables, or electrical or scientific instruments of any kind. We can, and do, make superior dynamos and motors, and if we are lamentably inferior to them in their practical application to traction work, again the blame must be laid, not to our want of brain, but rather to obstacles placed in the path of our progress by the obtuse conservatism of our politicians, and the still more obtuse acquiescence therein of our engineers and manufacturers.

It is no detraction from American greatness to say that but a very small percentage of the scientific discoveries, to the practical development of which she owes her fame, is due to native-born citizens of that magnificent country. It rather points to the difference between their national methods, which encourage inventors and the undertaking of grand schemes of public works whether local, county or State, and our own which discourages them, and so sends our best men to find a field for their talent abroad. Nothing can better demonstrate our high position in the world of applied science than the eagerness with which America avails herself, without regard to cost, of our best talent to assist in her great undertakings, opportunities for which occur almost weekly in that "country of magnificent distances," which are denied us in our overcrowded and diminutive areas.

We have been severely criticised for the absence in our shops of those labour-saving devices which are so prominent a feature in American, and the consequent greater efficiency of American schemes as compared with our own.

It must not be forgotten that skilled mechanics are more highly paid there than here, and the necessity for labour-saving devices is consequently greater. And here we are bound to admit that the average American mechanic is superior to ours in education and broadness of view as to his own value and work and the true interest of his employer.

But our first-class or high-grade mechanic is certainly equal to, if not the superior of, his American fellow, and, therefore, of the whole world.

As regards workshop devices for the saving of labour in the handling of material, they may perhaps be more advanced than ourselves, for their requirements are more urgent than our own. American manual labour has nothing to recommend it on the score of physical strength, or intelligence. It is nomadic, and therefore untrained, irresponsible, unmanageable and generally of a low order, being recruited from almost every nation under the sun. British manual labour has been defined as "brute strength and stupidity," but it is at least a class by itself, which is not difficult to train, and is willing and fairly manageable, under proper treatment, when it develops the feline characteristic of becoming attached to its locality, and is therefore permanent. Our necessity for expensive appliances for handling weights is not so absolute.

Finally, there comes the great Atlantic shipping scare, groundless and stupid. If the Americans in their great wealth are seized with a mania for possessing a mercantile marine of their own which they cannot produce themselves, they are perfectly justified in buying one. We are the shipbuilders of the world, it is our business to sell ships for the highest prices we can get, and profit thereon will help us to build better ones for our own use, and if they are not sold as well, we can man and work them better and cheaper than any nation on earth, and whilst others are trying to find out how to do the same, we can, if we want to, turn out more and finer ships than all the other yards in the world combined. The American combine may perhaps mean higher passage rates, which only affect a few, but it also means more work for our people generally, and more prosperity for our mechanics.

Much has been written about the superior education of the American mechanic, in which the writer is bound to say there is much truth. But although there is cause for regret, there is none for alarm.

The American had free education for all long before we recognised how vital a bearing it had on our welfare. But this superiority is rapidly being effaced, for the American critics themselves admit that our present educational system is superior to theirs, both literally and objectively.

A study of the Customs returns of one or both countries will convince the alarmist that we still supply America with the largest share of goods for her own consumption. Each country, however, has a field of its own, and it must be expected that in the inevitable changes in the supply and demand for labour and material, one or the other will occasionally overlap. When they do, each will be able to learn something from the other, and, if wise, will benefit thereby. To recognise this truth will do more good to our neighbours than all the belittlement of a whole army of drummers they may send over to preach the gospel according to St. Johnathan of our decadence, and more good to ourselves than to tamely accept as true the wailings of a lot of calamity howlers whose only excuse for existence is that they are fit for or can find nothing else more lucrative to do.

On one point the Americans are most decidedly our superiors. Their successes are "boomed" for all they are worth by the serious as well as the spread-eagle Press, and their failures are, if incapable of being converted into successes, just as silently buried.

With us, our greatest successes are taken as a matter of course of daily occurrence and pass unnoticed, but when a failure does happen we seem to take a melancholy pleasure therein, and invite the aid of our competitors to make it notorious. This self-denying humility is, perhaps, a result of our early training, but, as an American friend of the writer remarked, "It may be good Biblical, but it ain't good biz."

For generations to come there will be work enough to do for the rest of the world to keep every shop and every mechanic in England and America fully occupied. Both nations will have such a grip on it that nothing can loosen. Let us be convinced of the truth of this, and we shall cease to get up a hurricane scare every time we meet a little head breeze.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

11,454. "Improvements in register dials for gas, water, and electricity meters." C. Carew-Gibson. May 20th.

11,460. "Improvements in and relating to the electrical propulsion of tramway cars, railway carriages and the like." R. C. Thomson. (D. Kempt, Argentine Republic.) May 20th.

11,487. "Improvements in electric cables." G. Harrison, of D. Young and Co. (Kabelfabrik Actien-Gesellschaft, Austria.) May 20th. (Complete.)

11,499. "Improvements in and relating to electric low water alarms for steam boilers." G. C. Marks. (G. Fuller, United States.) May 20th. (Complete.)

11,500. "Improvements in multiple switches." G. C. Marks. (The Cutler-Hammer Manufacturing Company, United States.) May 20th. (Complete.)

11,508. "Improved process for the preparation of electrodes or secondary batteries." W. P. Thompson. (Akkumulatoren- and Elektricitäts-Werke Aktien Gesellschaft vormals W. A. Boese & Co., Germany.) May 20th. (Complete.)

11,509. "Process for the production of electrodes for secondary batteries." W. P. Thompson. (Akkumulatoren and Elektricitäts-Werke Aktien Gesellschaft vormals W. A. Boese & Co., Germany.) May 20th. (Complete.)

11,510. "Improvements in electric incandescent lamps with rare earth filaments." W. A. Crook and E. Mines. May 20th.

11,516. "Improvements in apparatus for electrically operating tools." H. J. Haddan. (J. S. Andrews and W. M. Simpson, United States.) May 20th.

11,567. "A new and improved receiver for wireless telegraphy." L. H. Walter. May 21st.

11,610. "Improvements in elastic cushions or buffers for electric light shades and the like." A. Marr. May 22nd.

11,692. "Improvements in wireless telegraphy." E. P. Thompson. May 22nd.

11,725. "Improvements in or relating to metallic conduits and fittings for electric cables and the like." L. M. Waterhouse and the Simplex Steel Conduit Company, Limited. May 23rd.

11,728. "An improved electrical switch." O. Pearson. May 23rd.

11,765. "A method of measuring temperature at a distance by electrica means." C. W. S Crawley and A. P. Trotter. May 23rd.

11,800. "An improved electrical indicator." A Denny and J. A. Robertson. May 24th.

11,814. "Improvements in means for preventing commutator sparking in dynamo-electric machines." H. H. Lake. (General Electric Company, United States.) May 24th.

11,815. "Improvements in electric railway systems." H. H. Lake. (General Electric Company, United States.) May 24th.

11,816. "Improvements in or relating to variable speed electromotors." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,817. "Improvements relating to electric railways." H. H. LAKE. General Electric Company, United States.) May 24th.

11,818. "Improvements in electric switches." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,819. "Improvements relating to the insulation of the conductors or windings of electrical apparatus." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,820. "Improvements in or relating to systems of electrical connections for current measuring instruments." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,821. "Improvements in electrical brush-holders." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,822. "Improvements relating to the control of electro-motor and other electric circuits." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,823. "Improvements in and relating to regenerative apparatus for railway and similar purposes." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,824. "Improvements relating to dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,825. "Improvements in electric transformers." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,826. "Improvements in rheostats." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,827. "Improvements in magnetic clutches." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,828. "Improvements relating to the regulation of dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,829. "Improvements in starting devices for electro-motors." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,830. "Improvement in brush-holders for dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,831. "Improvements relating to the field magnets of dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,832. "Improvements in oil guards for the commutators of dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.)

11,833. "Improvements in electric switches." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,834. "Improvements in electric condensers." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,835. "Improvements in electric speed regulators." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,836. "Improvements in commutator brushes for dynamo-electric machines." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,837. "Improvements relating to electric railways." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,838. "Improvements relating to controllers for electric motors." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,839. "Improvements in or relating to controlling devices for electric arcs." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,840. "Improvements in cleats or holders for electric conductors." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,841. "Improvements in apparatus for measuring the potential or strength of electric currents." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,842. "Improvements in electric meters." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,843. "Improvements in fuses for electrical purposes." H. H. LAKE General Electric Company, United States.) May 24th.

11,844. "Improvements in or relating to devices for controlling electric motors." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,845. "Improvements in electric plug fuses." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,846. "Improvements relating to railway signal apparatus." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,847. "Improvements relating to variable speed driving mechanism." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,848. "Improvements relating to variable speed driving mechanism." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,849. "Improvements in devices for controlling motors from a distance." H. H. LAKE. (General Electric Company, United States. May 24th.

11,850. "Improvements relating to volt-ampere meters or direct-current watt meters." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,851. "Improvements relating to the windings of electric transformers and other high potential windings." H. H. LAKE. (General Electric Company, United States.) May 24th.

11,889. "Improvements in electric devices for igniting mines." W. NORRES. May 24th. (Complete.)

11,914. "Improvements in electricity maximum demand indicators." G. C. FRICKER. May 24th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

6,023. "Improvements in electric bells." British Electric Works Company and S. Brander. Dated March 31st, 1900. Relates to an electric bell in which a bent iron bracket supports a single coil electro-magnet, the dome, the armature and its contact spring. The armatures work in a recess in the base board. The cone and bracket serve as conductors. 3 claims.

6,025. "Improvements in brush-holders for dynamo-electric machines." E. W. Mix. Dated March 31st, 1900. A holder for carbon brushes consists of a collar capable of being clamped on to the carrying stud, and having secured to it an adjustable brush guide or cage, made of drawn metal, and attached to the collar by screws passing through holes drilled at equal distances therein. A coil spring carried by adjustable clamping-plates bears upon the head of a screw adjustable in a screw collar, the said collar also serving to bind the terminal of the flexible connection to a metal cap on the brush. 5 claims.

6,034. "Improvements in automatic fire annunciation and position indicating apparatus." G. H. Oatway (C. E. May). Dated March 31st, 1900. Relates to an alarm which is only started by sudden rises of temperature, and which may be used in mines and ships as well as in other places. A wire, preferably of copper, is stretched between the ends of a more massive frame of the same materials. When this system is suddenly heated the wire expands faster than the frame, and the consequent sag lowers a weight till it makes contact with a terminal, and thus closes the alarm circuit, which also contains one of the magnets of the indicator, and thereby indicates the locality of the fire. Several modifications are described. 4 claims.

6,069. "Improvements relating to the generation of direct electrical currents and to apparatus therefor." R. Lundell, U.S.A. Dated March 31st, 1900. Relates to the production of pulsatory direct or almost constant currents in a dynamo-electric machine, having a number of armature conductors connected in series relation, without the aid of a commutator. The working parts of the machine are so arranged that a given conductor is always cut by lines of force which flow in the same direction. The armature coil revolves within a stationary field magnet excited by a battery or otherwise, and supplies currents to the winding of a second field magnet revolving with it. Within this magnet is arranged stationary armature coil in which the pulsatory or continuous currents generated. By interposing a pair of collecting-rings in the circuit of the o the machine may be used for rectifying alternating currents. 3 claims.

6,138. "Improvements in and relating to synchronous motors." A. F. Spooner. Dated April 2nd, 1900. Relates to a method of synchronising two electro-motors, which may be used to drive simultaneously a phonograph and a cinematograph. 3 claims.

6,150. "Improvements in conveying apparatus." Lamson Pneumatic Tube Company and R. T. Jouney. Dated April 2nd, 1900. Relates to a pneumatic electric despatch system, in which the electric circuit for driving the motor of the exhausting fan is automatically closed upon taking a carrier from its stand for use. 7 claims.

6,153. "Improvements in and connected with electrically-propelled motor vehicles." P. M. Justice. Dated April 2nd, 1900. Relates to the application of storage batteries to electrically-propelled vehicles, and comprises means for suspending such batteries, loading and unloading the same, and automatically making the electrical connections. 11 claims.

6,188, "Improvements in armoured conduits for electric wires." J. B. Boutillier and W. B. Hunter. Dated April 3rd, 1900. Conduits are formed of metal tubes provided with a lining of asbestos. The asbestos is applied in a spiral form by first rolling on a slightly smaller mandrel, which is rotated to expand the spiral and compact it against the inside of the metal tube. The asbestos may be cemented in position. 2 claims.

6,218. "Improvements in machines for electrically heating, welding or working metals." C. L. Coffin. Dated April 3rd, 1900. Metal is welded or heated for upsetting or otherwise working by electricity by fixing the metal in two clamps, the upper jaws of which are operated by a treadle through levers. The clamps can be moved towards or away from each other, and are both carried on a slide, which can move in a direction at right angles to the plane on the paper. A carbon electrode, carried on a lever, is brought near the metal to be heated in order to form an arc therewith, and it can be adjusted to the right or left by a screw. A coloured glass screen on the lever is moved with the electrode, but through a greater space. 8 claims.

6,230. "Improvements in lamp shades or globes." W. L. Strachan. Dated April 3rd, 1900. The gas, electric, or other light is refracted and diffused by spirally wound cylindrical glass rod, which is protected from injury and dirt by two preferably plain glass casings. These casings are hermetically sealed at their edges by plaster or cement. 8 claims.

6,237. "Improved electrical gas igniting apparatus." J. Schwarzenbach. Dated April 3rd, 1900. In this electrical induction sparking apparatus, the electro-magnets form part of the primary circuit, and the ignition apparatus is arranged in the secondary circuit, a contact in the latter circuit being automatically closed by the movement of the armature of the electro-magnets. 5 claims.

6,244. "Improvements in plates for secondary electric batteries." L. David. Dated April 3rd, 1900. Relates to electrodes for secondary batteries and for electrolytical purposes. Each plate is made up of a number of bars, arranged between two horizontal supports. 2 claims.

6,261. "Improvements in electric switches and resistances." C. W. Atkinson. Dated April 3rd, 1900. Relates to resistance switches particularly adapted for shunt-wound motors, and means are provided for preventing the resistances from being cut-out too rapidly, and also to open the circuit should the current exceed a limit or fail. 7 claims.

6,286. "Improvements in electric furnaces." W. Borchers. Dated April 4th, 1900. A continuous furnace, for making carbide, or other purposes, is provided below the heating-region with a jacket to cool the products below their temperature of combustion in the air, so that material unacted on may be immediately used again. The jacket may serve as a steam generator. 2 claims.

6,308. "Improvements in electric incandescent lamps." R. A. Fessenden. Dated April 4th, 1900. A lamp having an incandescence rod of magnesia, kaolin, or the like, conducting only after preliminary heating, and having either a concave radiating heater, or a means for applying to the rod a streak of graphite or other conducting material when the lamp is about to be used, is provided with an automatic electro-magnetic switch to at first connect wires carrying a pressure higher than normal to the heater or the incandescence rod, the pressure being lowered as the rod becomes conductive, until eventually it is connected directly to the normal supply wires. The rod may otherwise be heated previously by a lamp. 11 claims.

6,312. "Improvements in apparatus for the production of soda and chlorine by the electrolysis of chloride of sodium." A. H. Cohu and E. Geisenberger. Dated April 4th, 1900. Apparatus for decomposing chlorides of sodium, potassium, magnesium, aluminium, or barium, for the purpose of obtaining the corresponding hydrate or metal and chlorine. 6 claims.

6,384. "Improvements in apparatus for welding and working metals." C. L. Coffin. Dated April 5th, 1900. The article, for instance, a ring for uniting the frames of bicycles, is supported in a clamp moving on a slide, and operated by a lever. It is moved over a fixed rod, forming the hearth or base of an electric furnace, and when heated, is transferred to a mandrel or anvil, where it is welded by a spring hammer, operated by a cam through a lever, and held out of operation by a treadle-operated lever. The furnace is mounted on rails, and can be run over a hearth at each ends of the machine; it can be adjusted vertically and transversely also. 10 claims.

6,385. "Improved methods of and apparatus for electrically separating the relatively volatile liquid components from the component relatively fixed substance of composite fluids." J. F. Cooley. Dated April 5th, 1900. Relates to mixtures of liquids, and to means for separating the more volatile liquids from the less volatile liquids, and to the concentration or solidification of the latter. 7 claims.